

**REMEDIAL ACTION CONTRACT 2 FOR
REMEDIAL, ENFORCEMENT OVERSIGHT, AND
NON-TIME-CRITICAL REMOVAL ACTIVITIES
IN REGION 5**

**FINAL FOCUSED FEASIBILITY STUDY REPORT
OPERABLE UNIT 1**

**LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART
ELKHART COUNTY, INDIANA**

**Prepared for
United States Environmental Protection Agency
Region 5
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ACRONYMS AND ABBREVIATIONS

µg/L	Microgram per liter
ARAR	Applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	<i>Code of Federal Regulations</i>
COC	Constituent of concern
COI	Constituent of interest
CSM	Conceptual site model
CTE	Central tendency exposure
CVOC	Chlorinated volatile organic compound
DCA	Dichloroethane
DCE	Dichloroethene
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FFS	Focused Feasibility Study
GIS	Geographic information system
gpm	Gallon per minute
GRA	General response action
HHRA	Human health risk assessment
HI	Hazard index
HVAC	Heating, ventilation, and air conditioning
IC	Institutional control
IDEM	Indiana Department of Environmental Management
IRIS	Integrated Risk Information System
Lusher Site	Lusher Street Groundwater Contamination Site
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable unit
PCB	Polychlorinated biphenyl

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PCE	Tetrachloroethene
POTW	Publicly owned treatment works
PSA	Potential source area
PVC	Polyvinyl chloride
RAL	Remedial action level
RAO	Remedial action objective
RI	Remedial investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Level
SLERA	Screening level ecological risk assessment
SSD	Sub-slab depressurization
SVOC	Semivolatile organic compound
TCA	Trichloroethane
TCE	Trichloroethene
Tech Memo	“Remedial Alternatives Screening Technical Memorandum”
TTHM	Total trihalomethanes
UV	Ultraviolet
VAS	Vertical aquifer sampling
VI	Vapor intrusion
VISL	Vapor Intrusion Screening Level
VOC	Volatile organic compound
Weston	Weston Solutions, Inc.
WWTP	Wastewater treatment plant

1.0 INTRODUCTION

Under Work Assignment No. 136-RICO-05AB, Remedial Action Contract No. EP-S5-06-02 (RAC 2), SulTRAC prepared this Final Focused Feasibility Study (FFS) report for the Lusher Street Groundwater Contamination Site (Lusher Site) in the City of Elkhart, Elkhart County, Indiana, for the U.S. Environmental Protection Agency (EPA) Region 5. The purpose of the work assignment is to conduct a remedial investigation (RI)/FS at Operable Unit (OU) 1 of the Lusher Site to select a remedy that eliminates, reduces, or controls risks to human health and the environment. As a first step, this FFS report presents information needed to support an informed risk-management decision regarding which interim remedy appears most appropriate for the Lusher Site. The use of brand names within this report is for reference purposes only and does not represent an endorsement of the item by SulTRAC or EPA.

The Lusher Site occupies about 870 acres and is composed of mixed residential, commercial, and industrial areas presently served by both municipal water and private water supply wells. The Lusher Site is located on the western side of the City of Elkhart and is bounded approximately by West Hively Avenue on the south, Nappanee Street on the west, the St. Joseph River on the north, and Oakland Avenue on the east ([Figure 1-1](#)). The Lusher Site is divided into two OUs: OU 1 – Site-Wide Groundwater and Vapor Intrusion (VI) and OU 2 – Source Control. This FFS report focuses on OU 1, Site-Wide Groundwater and VI. After an interim OU 1 remedy is selected to address current potential exposures, OU 2 will be addressed as part of a separate RI/FS. At this time, it is anticipated that two Final Records of Decision (ROD), one for OU 2 and one for OU 1, will be prepared following the completion of an RI/FS for OU 2, and possibly a supplemental RI/FS for OU 1.

The rest of this section discusses the FFS report purpose and objectives ([Section 1.1](#)) and the report organization ([Section 1.2](#)), and presents a summary of the RI ([Section 1.3](#)).

1.1 FOCUSED FEASIBILITY STUDY REPORT PURPOSE

The FS process is defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 guidance; and (most specifically) in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" ([EPA 1988](#)). The FS process was developed to gather sufficient information to support an informed risk-management decision regarding which remedy appears most appropriate for a given site. The RI phase included data collection and risk assessment efforts ([SulTRAC 2013](#)).

This FFS report uses information gathered during the RI to identify and evaluate remedial alternatives that appear most appropriate for OU 1 of the Lusher Site. The objective of an FFS is to develop and evaluate remedial alternatives that will (1) address unacceptable risks to human health and the environment identified in the RI report ([SulTRAC 2013](#)) and (2) meet applicable or relevant and appropriate requirements (ARAR). As specified in the NCP, the potential alternatives encompass a range of alternatives in which treatment or controls are used to reduce the toxicity, mobility, or volume of contaminants but vary in the degree to which long-term management of residual or untreated contamination is required.

This FFS report provides interim alternatives designed to eliminate exposure pathways. Because the multiple sources of contamination have not all been identified, investigated, and remediated, long term alternatives are not provided because the selection of a long term alternative may be inconsistent with a source control remedy and, once source control remedies are implemented, a long term alternative may not be necessary. Interim alternative measures are similar to those used before at some locations within the Lusher Site (providing filters and municipal water connections) and at other sites. Exposure at many groundwater treatment sites is reduced by actions taken under the removal program (such as providing alternate water supplies and installing VI mitigation systems) while investigations proceed toward identifying a long-term remedy.

EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" specifies that the FS process should be flexible. Therefore, each RI/FS process may vary in its specifics ([EPA 1988](#)). The general steps of this FFS are summarized below.

1. **Identifying ARARs:** Remedial actions performed under CERCLA must meet ARARs for selected remedies unless a specific ARAR waiver is requested. ARARs are federal, state, and local public health and environmental requirements used to (1) characterize the extent of Site cleanup, (2) identify sensitive land areas and land uses, (3) develop remedial alternatives, and (4) direct site remediation. CERCLA and the NCP require that remedial actions comply with federal ARARs and also with state and local ARARs that are more stringent than their federal counterparts as long as they are legally enforceable and consistently enforced. ARARs are evaluated early in the work planning process so that field work can be designed to collect data necessary to satisfy ARAR requirements and, if necessary, to identify and evaluate remedial alternatives relative to ARARs.
2. **Establishing Remedial Action Objectives (RAO):** Site-specific RAOs that are protective of human health and the environment are identified. The RAOs specify the constituents of concern (COC), exposure routes, and receptors.
3. **Establishing Remedial Action Levels (RAL):** RALs are risk-based or ARAR-based chemical-specific concentrations that further define the RAOs. RALs are used to estimate the extent of

contamination requiring remedial action. This FFS report focuses on OU 1, Site-Wide Groundwater and VI.

4. **Developing General Response Actions (GRA):** GRAs are developed by defining containment, treatment, excavation, or other actions, singly or in combination, to satisfy the RAOs. The GRAs take into account requirements for protectiveness as identified in the RAOs and based on the Site's chemical and physical characteristics.
5. **Identifying and Screening Remedial Technologies:** Applicable remedial technologies are identified and screened against the developed GRAs. Treatment technologies are identified and screened so that the most applicable technologies are selected for the COCs present and the Site's characteristics. Screening primarily is based on a technology's ability to address the COCs effectively but also includes implementability and cost considerations.
6. **Developing Remedial Alternatives:** Representative remedial technologies are carried forward into the alternative development stage. The effort includes combining representative technologies and GRAs into alternatives, assessing the appropriateness of the suggested alternatives, and developing the alternatives in sufficient detail for identification of action-specific ARARs.
7. **Screening Remedial Alternatives for Effectiveness, Implementability, and Cost:** Potential remedial alternatives are screened with respect to effectiveness, implementability, and cost before they are considered for detailed evaluation.
8. **Performing a Detailed Analysis of Remedial Alternatives:** The detailed analysis of alternatives presents the relevant information needed to compare the remedial alternatives. Detailed analysis of alternatives consists of a detailed evaluation of each alternative against the evaluation criteria set forth in the NCP.
9. **Performing a Comparative Analysis of Remedial Alternatives:** Once the alternatives have been individually assessed against the evaluation criteria, a comparative analysis is conducted to evaluate the performance of each alternative in relation to each evaluation criterion. This process is in contrast to the analysis discussed in Step 8 above, in which each alternative is analyzed independently, without considering other alternatives. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to the others so that decision-makers can identify and balance the key advantages and disadvantages of each alternative.

The FS process described above was followed for OU 1 of the Lusher Site with some limitations because one of the issues at the Site is VI. EPA Region 5 has issued a guidance document for VI, "Vapor Intrusion Guidebook," which indicates that remedial decisions on VI risk should be based on a cancer risk of 1×10^{-5} and a non-cancer hazard index (HI) of 1, and which identifies a few remedial approaches to VI that have been demonstrated to work ([EPA 2010](#)).

The "Remedial Alternatives Screening Technical Memorandum" (Tech Memo) was prepared to develop and conduct preliminary evaluations of technologies that will remediate or control contaminated groundwater and related VI at OU 1 of the Lusher Site to provide adequate protection of human health and the environment ([SulTRAC 2012](#)). Remedial technologies were screened to identify preliminary remedial alternatives. The Tech Memo completed Steps 1 through 6 of the FS process discussed above.

1.2 REPORT ORGANIZATION

This report consists of the six sections summarized below.

- **Section 1.0, Introduction:** This section discusses the FFS purpose and report organization, and presents a summary of the RI.
- **Section 2.0, Identification and Screening of Technologies:** This section discusses the regulatory framework supporting this FFS, including the remedial objectives, ARARs, RAOs, and RALs. The section then discusses the proposed interim remedial alternatives, the GRAs, and the identification and screening of technologies, including a summary of the retained technologies.
- **Section 3.0, Development of Remedial Alternatives:** This section describes the interim remedial alternatives developed based on the screening of technologies and discusses the pre-remedial sampling plan for VI at OU 1.
- **Section 4.0, Detailed Analysis of Retained Alternatives:** This section discusses the screening criteria for the alternatives and presents a detailed analysis of each retained alternative, including a detailed description of the alternative and an evaluation against each screening criterion.
- **Section 5.0, Comparative Analysis of Alternatives:** This section presents a direct comparison of the selected alternatives based on the evaluation criteria.
- **Section 6.0, References:** This section lists the references used to prepare this report.

[Section 2.0](#) and [Section 3.0](#) of this FFS report contain essentially the same information included in the Tech Memo ([SulTRAC 2012](#)). [Section 4.0](#) and [Section 5.0](#) of this FFS report present additional analysis and evaluation of alternatives not included in the Tech Memo.

1.3 SUMMARY OF REMEDIAL INVESTIGATION

The purpose of the RI at OU 1 was to evaluate the nature and extent of contamination in groundwater and soil vapor (including sub-slab and indoor air samples) and to assess the associated human health risks. This section provides a brief summary of the major RI findings, including conclusions regarding data limitations and recommendations for future work. Specifically, the following sections summarize the Site description ([Section 1.3.1](#)), Site history ([Section 1.3.2](#)), conceptual site model (CSM) ([Section 1.3.3](#)), nature and extent of contamination for both groundwater and VI ([Section 1.3.4](#)), contaminant fate and transport ([Section 1.3.5](#)), the human health risk assessment (HHRA) ([Section 1.3.6](#)), the screening-level ecological risk assessment (SLERA) ([Section 1.3.7](#)), and the RI conclusions and recommendations ([Section 1.3.8](#)).

1.3.1 Site Description

The Lusher Site in Elkhart, Elkhart County, Indiana, occupies about 870 acres. The estimated population living within the Site boundaries is approximately 2,600 (Indiana Department of Environmental Management [IDEM] 2007). The Site is composed of mixed residential, commercial, and industrial areas bisected by a railroad and served by a mixture of private wells and public water. In the City of Elkhart, five Superfund sites are or have been on the National Priorities List (NPL): the Himco Dump Site, the Main Street Well Field, the Conrail Rail Yard, the Lane Street Groundwater Contamination Site, and the Lusher Street Groundwater Contamination Site (Agency for Toxic Substances and Disease Registry [ATSDR] 2009). Figure 1-2 shows the sites on the NPL in the Elkhart area. The Himco Dump, the Main Street Well Field, and the Lane Street Groundwater Contamination Site all are located north of the St. Joseph River. The Conrail Rail Yard and the Lusher Site both are located south of the St. Joseph River.

The Lusher Site encompasses the area of a plume of groundwater contaminated by volatile organic compounds (VOCs). The source(s) contributing to the Lusher Street groundwater plume has not been fully identified. Potential sources of groundwater contamination have been identified, and unidentified additional sources also may exist near and within the Lusher Site area. Nearby groundwater plumes that have been identified include the Gemeinhardt plume south and southwest of the Site and the Conrail Rail Yard plumes west of the site (ATSDR 2009). In 2009, Weston Solutions, Inc. (Weston), conducted a preliminary investigation for the Lusher Site and identified nine potential source areas (PSA) (Weston 2010). The RI report discusses the identified PSAs in detail (SulTRAC 2013). The Site was named after Lusher “Street” because it originally was assumed that most of the contamination was from businesses on Lusher Avenue.

The Lusher Street groundwater plume presently primarily contains chlorinated solvents, including tetrachloroethene (PCE); trichloroethene (TCE); chloroform; 1,1-dichloroethane (DCA), and vinyl chloride (SulTRAC 2013). Historically, 1,1,1-trichloroethane (TCA), 1,1-dichloroethene (DCE), and 1,2-DCE have also been a concern. Note that some of the contaminants are present only in localized areas. This FFS report collectively refers to these contaminants as chlorinated volatile organic compounds (CVOCs).

Currently, properties at the Lusher Site obtain drinking water from both public and private water supply wells. Although the depths of the private wells are unknown, the wells are suspected to be shallow and are located in the sand-and-gravel St. Joseph Aquifer beneath the Site. SulTRAC identified 94 private wells within the boundaries of the Lusher Site. A combined sewer system in Elkhart discharges to the Elkhart

wastewater treatment plant (WWTP) and to the St. Joseph River during periods of unusually high discharge. The St. Joseph River currently is used for recreational purposes and has a number of public parks and docks as well as private docks accessible along the river ([SulTRAC 2013](#)).

1.3.2 Site History

Historical aerial photographs from 1938, 1965, 1967, 1973, 1981, and 1987 from the National Aerial Survey Center/Visual Image Presentation, U.S. Geological Survey, and U.S. Department of Agriculture / Farm Service Administration show the Lusher Site over time. [Figure 1-3](#) presents aerial photographs of the Site from 1938, 1951, 1981, and 2012. The aerial photographs indicate that businesses along the north side of Lusher Avenue were built on former railroad property. The 1938 aerial photograph shows that the area from Lusher Avenue north to Franklin Street contained staged railroad cars and a central building. On the 1938 aerial photograph, most of the southern and northwestern portions of the Lusher Site consist of farmland, with some residential properties. The apparent beginnings of some industrial activity at the parcel currently owned by Elkhart Plating on 14th Street are discernible on the 1938 aerial photograph.

By 1965, railcars no longer were staged south of the railroad tracks and several businesses were developed along Lusher Avenue, including a scrap metal yard (currently Heavy Metal Recycling). Several large industrial/commercial properties were developed near the southeastern portion of the Lusher Site south of Fieldhouse Avenue and east of 18th Street. Early development of the Elkhart WWTP is visible along Nappanee Street near the St. Joseph River. Some development also is visible between the railroad tracks and Franklin Street.

By 1973, the Elkhart WWTP had expanded to its current configuration, and additional residential / commercial buildings were constructed in the northwest portion of the Lusher Site. The large farm field in the northeast corner by Hively Avenue and Nappanee Street was developed with industrial / commercial buildings, and several additional buildings and businesses were developed along the north side of Lusher Avenue. A shopping center was developed on the northeast corner of Franklin Street and Nappanee Street, and limited development was beginning south of Franklin Street and north of the railroad tracks.

By 1981, additional development is visible along Lusher Avenue and Franklin Street, with some development along Nappanee Street north of West Indiana Avenue. By this time, much of the vacant land had been developed. Minimal additional development took place between 1981 and 2011, although businesses may have changed or closed during the last 30 years.

1.3.3 Conceptual Site Model

Figure 1-4 shows the CSM for the Lusher Site, including potential sources, release mechanisms, exposure pathways and migration routes, and potential receptors. The CSM indicates multiple potential sources of CVOCs, mostly south of the railroad tracks. Multiple releases are responsible for contamination found at the Lusher Site since the 1980s. These releases to soil migrated down to the sand-and-gravel St. Joseph Aquifer. Contamination migrates through groundwater toward the river. Near the river, groundwater has an upward gradient, potentially entering the river. Shallow contamination volatilizes into soil vapor and migrates toward the surface. Where buildings are present, there is a potential for VI. Contaminated groundwater also is a direct exposure pathway when pumped by private wells and used for potable purposes.

The OU 1 CSM shows that groundwater, sub-slab soil vapor, and indoor air are the potentially affected media at the Lusher Site. (The impacts on soil will be examined in OU 2.) The CSM also shows that the Lusher Site includes historical and current industrial areas and residential areas, all within an urban setting. As part of OU 1, the fate and transport of the following groundwater constituents of interest (COIs) were evaluated: TCE, 1,1,1-TCA (based on historical data), PCE, and chloroform, and their degradation products, 1,1-DCE, 1,2-DCE, and vinyl chloride. Generally, the water table lies at approximately 8 and 15 feet below ground surface (bgs), and groundwater generally flows toward the St. Joseph River. The COIs are mobile in groundwater moving through the St. Joseph Aquifer beneath the residential area. Human and ecological receptors could be exposed to the COIs through two primary routes: inhalation of vapors from contaminated groundwater (VI) and direct ingestion of groundwater. A secondary exposure route is groundwater migrating to and entering the river. VI can affect many properties, regardless of the water source. Direct ingestion of groundwater is a potential concern for properties using private water wells as a potable water source. Based on information obtained for the RI, within the Site boundaries, approximately 131 properties with buildings are not on municipal water supply. This number may change as buildings are built, condemned, or demolished. (As will be described later in the FFS, only a subset of these properties not on municipal water supply are proposed for interim remediation). Groundwater that has migrated to surface water also is a potential exposure route, but it is a minor one from a human health standpoint and not an issue from an ecological standpoint.

The main contaminant currently present in groundwater is TCE, although other VOCs also have been detected. In the past, 1,1,1-TCA was a main contaminant, but 1,1,1-TCA concentrations have decreased significantly as discussed in the RI report ([SulTRAC 2013](#)). Cis- and trans-1,2-DCE and vinyl chloride also have been detected, and all three chemicals can be degradation products of TCE. However, as

discussed in the RI report ([SulTRAC 2013](#)), throughout most of the Lusher Site, there is limited evidence of biodegradation. PCE and vinyl chloride also are groundwater COIs. The multiple sources correspond with multiple groundwater contamination plumes and commingle with other plumes at some locations.

One or more of the potential sources has created a TCE plume at the water table. The TCE in this plume could volatilize from groundwater at the water table, migrate upward through soil, and enter buildings through various openings in the foundation, including cracks, sumps, utility entrances, and by permeating through the foundation material. Residents and others inside the buildings could inhale the vapors. The Lusher Site also contains deeper plumes overlain by uncontaminated groundwater. Uncontaminated groundwater above these deeper plumes creates a barrier that prevents the deeper contamination from entering soil vapor. Therefore, the deeper plumes do not have a complete VI pathway. However, residents could be exposed to contaminants in the deeper plumes if groundwater from the contaminated interval is used for domestic purposes.

Current and former gasoline stations, several of which are located within the Lusher Site, could be a source of petroleum-related contaminants (such as benzene, toluene, ethylbenzene, and xylenes [BTEX]). Former gasoline stations also could be sources of petroleum vapors. Other potential sources for petroleum-related compounds include facilities located within or near the Lusher Site that store petroleum products. Based on the RI soil vapor and indoor air results, every time that benzene was detected, one or more of the BTEX compounds also was present, indicating that the source may be petroleum-based. Petroleum contamination usually is excluded from consideration under CERCLA unless it becomes commingled with other hazardous substances.

1.3.4 Nature and Extent of Contamination

This section summarizes the nature and extent of contamination at the Lusher Site. Detailed descriptions and analyses of the nature and extent of contamination are presented in Section 5.0 of the RI report ([SulTRAC 2013](#)).

SulTRAC collected groundwater samples and performed a VI evaluation as part of the RI field activities. For the groundwater investigation, groundwater samples were collected from 54 private wells as well as 135 groundwater samples for vertical aquifer sampling (VAS) at 20 locations and 93 groundwater samples from 31 monitoring wells at 15 locations. As part of the VI evaluation, groundwater samples from the water table were collected from 53 locations; soil vapor samples collected just above the water table at 28 locations; and a total of 59 sub-slab, 1 crawl space, 6 outdoor air, and 50 indoor air samples were collected from 29 different properties. All groundwater samples were analyzed for VOCs. A subset

of the groundwater samples from residential wells also was analyzed for metals, polychlorinated biphenyls (PCBs), pesticides, and semivolatile organic compounds (SVOCs) to assess whether these contaminants are present at the Lusher Site. All soil vapor, sub-slab, and indoor air samples were analyzed for VOCs. The primary conclusions from the evaluation of the nature and extent of contamination from the Final RI are summarized below.

- No PCBs, pesticides, or SVOCs were identified as COIs.
- Arsenic was identified in the HHRA as a potential risk driver for groundwater ingestion; however, all detected arsenic concentrations in groundwater are less than the Maximum Contaminant Level (MCL), and therefore arsenic was not considered to be a COI for the nature-and-extent discussion.
- No other metals were identified as risk drivers in the HHRA or COIs in the nature-and-extent discussion of the Final RI.
- Nine VOCs (1,1,1-TCA, 1,1-DCA, benzene, chloroform, cis-1,2-DCE, methylene chloride, PCE, TCE, and vinyl chloride) were identified as groundwater COIs.
- Six VOCs (1,1-DCA, benzene, chloroform, PCE, TCE, and vinyl chloride) were identified as COIs in vapor, based on soil vapor, sub-slab, and indoor air screening but only two of these, TCE and PCE, were confirmed to have a complete VI pathway.
- Based on the screening of soil vapor, sub-slab, and indoor air sample results, only two COIs had a complete VI pathway, TCE and PCE.
- The VI pathway was confirmed to be complete in 21 of the 29 residences from which paired sub-slab and indoor air samples were collected for the Final RI (Note that a complete pathway does not necessarily mean that remediation is required).
- At the residences where the VI pathway is complete, none of the concentrations exceeded the removal action levels used by Region 5 (based on three rounds of data).
- Samples from two private wells contained VOCs at concentrations exceeding the MCLs. The property owners have been notified. As of the time of writing, one of these properties, an industrial property, is using bottled water; the other is a residence which the City has deemed uninhabitable.
- The HHRA also identified arsenic, 1,2-dichloroethane, 1,4-dichlorobenzene, and carbon tetrachloride as potential risk drivers. As discussed in the RI and in Section 1.3.8 of this report several of these chemicals were not recommended for further evaluation.

CVOCs are the primary COIs at OU 1. TCE was detected above the MCL in the residential wells and is the main COI for VI. Other VOCs were detected during previous investigations at concentrations exceeding the MCLs, including 1,1,1-TCA, which was detected at relatively high concentrations during previous investigations but at significantly lower concentrations in 2010, 2011, and 2012 during the RI at the Lusher Site outside the PSAs.

Metals detected in the residential well groundwater samples are believed to be attributable to natural sources. The maximum arsenic concentration of 2.6 micrograms per liter ($\mu\text{g/L}$) exceeded the Regional Screening Level (RSL) of 0.045 $\mu\text{g/L}$ but is well below the MCL of 10 $\mu\text{g/L}$. Manganese concentrations exceeded the revised 2012 RSL of 320 $\mu\text{g/L}$ at two locations; manganese has no MCL. The revised 2012 RSL for manganese accounts for both dietary and non-dietary exposure. The manganese concentrations detected in groundwater were below the previous RSL of 880 $\mu\text{g/L}$. The residential well samples did not contain PCBs, pesticides, or SVOCs at concentrations exceeding the screening levels and, therefore, these chemicals were not retained as COIs.

The lateral extent of impacted groundwater defines OU 1. The area where VOC concentrations exceed MCLs and where VI represents a potential threat primarily is located in the central and north-central portions of the Site. Based on the RI, the distribution of VOCs suggests several sources of contamination, and the sources of these plumes likely are located in or near the southern two-thirds of the plume area exceeding the MCLs. Because of the high permeability of the sand-and-gravel aquifer, groundwater contamination is expected to move rapidly, indicating that some of the historically observed contamination could have come from other sources and no longer is present.

1.3.5 Contaminant Fate and Transport

The Lusher Site is a mixed industrial, commercial, residential, and transportation site in an urban setting with multiple potential sources. The OU 1 CSM shows that the potentially affected media are groundwater, soil vapor (including sub-slab soil vapor) and indoor air (through VI). Multiple potential sources have been identified. EPA is pursuing addressing the contamination at these potential sources separately as part of OU 2, Source Control. The CSM for OU 1 in the RI report suggests multiple releases of VOCs, mostly south of the railroad tracks, at different times from different sources ([SulTRAC 2013](#)).

The Lusher Site overlies the St. Joseph Aquifer, which includes surficial materials overlying 140 to 160 feet of sand and gravel, which in turn overlie shale bedrock. The water table is located at approximately 8 to 12 feet bgs, and groundwater flows north-northwest toward the St. Joseph River. The estimated advective flow velocity of the St. Joseph Aquifer is 3.4 feet per day. Near the river, groundwater elevation contours are influenced by the river. Contaminants mainly are transported around the Site through groundwater flow, with associated contaminant migration and volatilization to soil vapor and subsequent VI or volatilization to the atmosphere. In some parts of the Site, the contaminated groundwater plume is in the deeper part of the aquifer and is overlain by clean, uncontaminated

groundwater, which acts as a barrier to VI. Both the HHRA and SLERA evaluated contaminated groundwater discharge to the St. Joseph River from the Site.

Potential migration routes for COIs at the Lusher Site were assessed based on the contaminant properties and fate-and-transport processes. The following potential migration pathways could release, deposit, or redistribute COIs in surface soil:

- Migration of contaminants in groundwater
- Volatilization of contaminants from groundwater into pore spaces of soil
- Subsequent migration of soil vapor and escape to the atmosphere or VI into residences and places of business

VI has been documented as occurring at the Lusher Site. However, not every structure in the VI area of concern actually is affected by VI. Many factors can affect the VI rate, including (but not limited to) outdoor temperature, pressure, and wind; relative temperature and pressure differences between outdoors and indoors; ongoing ventilation of buildings through windows, exhaust fans, other openings, and heating, ventilation, and air conditioning systems; the presence of snow or ice on the ground; and precipitation or yard or garden watering.

Based on the physicochemical characteristics of the COIs at the Lusher Site, all of the COIs are VOCs and tend to be fairly mobile. They are soluble enough in water to dissolve and migrate with groundwater. Their volatility and presence at the water table at part of the Site create the potential for VI.

Groundwater samples were collected to evaluate whether anaerobic biodegradation is occurring. Generally, samples from shallow depths showed inadequate to limited evidence for biodegradation of chlorinated volatile organic compounds except for samples from MW-005 in a PSA, which demonstrated strong evidence that contaminants were being biodegraded. Intermediate and deep monitoring wells showed limited evidence of biodegradation, with deeper wells showing relatively stronger evidence. Taken collectively, the data indicate that the primary fate of contaminants in groundwater is advective transport toward the St. Joseph River, with attenuation through dispersion and volatilization rather than biodegradation.

1.3.6 Human Health Risk Assessment Summary

This section summarizes the risks and hazards presented in the HHRA under current and future land use reasonable maximum exposure (RME) and central tendency exposure (CTE) conditions. Based on the

HHRA, the COIs at OU 1 are TCE; benzene; chloroform; ethylbenzene; 1,1-DCA; and methylene chloride. To a lesser extent, the COIs at OU 1 also include arsenic; 1,2-DCA; 1,4-dichlorobenzene; PCE; and carbon tetrachloride. Note that the HHRA used a slightly different methodology for identifying COIs than was done in the nature and extent section of the RI report. The HHRA evaluated all contaminants in indoor air, regardless of their attribution. In the RI, several of these chemicals were not recommended for further evaluation, as discussed in Section 1.3.8.

Under CERCLA, site-related cancer risks less than 1×10^{-6} and non-cancer risks less than 1 do not require further action. Site-related risks exceeding a 1×10^{-4} cancer risk or non-cancer risks exceeding 1 generally require action. Risks between 1×10^{-6} and 1×10^{-4} are within the acceptable risk management range and are evaluated on a site-specific basis. Section 300.430(e)(2) of the NCP establishes 1×10^{-6} as a point of departure for remedial goals when there are no ARARs. A property-specific risk assessment was performed at 73 properties: 69 residential properties and 4 industrial properties. The discussion below is organized by exposure type and concludes with a brief statement comparing RME and CTE results.

Residential and Industrial / Commercial Exposure

- Under both current and future land use conditions, 34 (45 percent) of the residential properties and 4 (80 percent) of the industrial properties sampled have acceptable risks (risk estimates less than 1×10^{-6} and HI values below 1). These properties primarily are located south of the railroad tracks.
- Under current and future land use conditions, 38 (51 percent) of the residential and one (20 percent) of the industrial properties have total risks within the risk management range of 1×10^{-6} to 1×10^{-4} and/or HI values exceeding 1. Most of these properties are located north of the railroad tracks. The total risks primarily are driven by inhalation through VI of COIs. Risks and hazards are driven primarily by vapor intrusion, primarily from TCE, benzene, chloroform, ethylbenzene, and 1,2-DCA; several other VOCs contribute to a lesser extent.
- Three properties (4 percent), all residential, had risks exceeding 1×10^{-4} and may also have HI values exceeding 1. All three properties are located within the VI area of concern north of the railroad tracks. Risk and hazards are driven by inhalation through VI of COIs and some other VOCs.

Utility Workers

- At 64 of the properties, both residential and industrial/commercial (80 percent), the risk to utility workers was within the acceptable range.
- At the remaining 16 properties (20 percent), the risk to utility workers was within the risk management range of 1×10^{-6} to 1×10^{-4} and/or HI values exceeding 1. All 16 properties are located within the VI area of concern. Risks and hazards are driven by inhalation of TCE within a trench.

Construction Workers

- At 63 of the properties (78 percent), the risk to construction workers was within the acceptable range.
- At the remaining 17 properties (22 percent), the HI value exceeded 1 and the risk was below 1×10^{-6} . All these properties are located within the VI area of concern. Hazards are driven by potential inhalation of TCE within a trench.

Recreational Exposure

- Based on qualitative evaluation of potential recreational exposure in the St. Joseph River, no significant risks or hazards were identified.

RME vs. CTE Conditions

- CTE property categories and risk and hazard drivers (COIs) are similar to those identified under RME conditions. However, the CTE risks are about 50 percent of RME risks.

1.3.7 Screening Level Ecological Risk Assessment Summary

A SLERA was conducted as part of the RI. A habitat evaluation concluded that two habitats that require evaluation are present at the Lusher Site: the aquatic habitat of the St. Joseph River and the forested wetland next to the St. Joseph River. Specific endpoints identified for the SLERA were benthic and aquatic communities in the St. Joseph River and the protection of threatened and endangered species. The SLERA concluded that aquatic receptors exposed to surface water in the St. Joseph River are not at risk for adverse effects from groundwater discharge from the Lusher Site.

1.3.8 Remedial Investigation Conclusions and Recommendations

The purpose of the RI at OU 1 was to evaluate the nature and extent of contamination in groundwater and soil vapor (including sub-slab and indoor air samples) and to assess the associated human health risks. Two primary sources of current and potential future risk from the Site were identified: inhalation of soil vapor through VI into residences and the potable use of groundwater.

Based on the HHRA, the COIs at OU 1 are TCE; benzene; chloroform; ethylbenzene; 1,1-DCA; and methylene chloride. To a lesser extent, COIs at OU 1 also include arsenic; 1,2-DCA; 1,4-dichlorobenzene; PCE; and carbon tetrachloride. The HHRA evaluated all contaminants in indoor air, regardless of their attribution. The discussion below takes into account potential ARARs (such as the MCL for arsenic) and attribution for vapor intrusion in its discussion. The RI findings for the COIs are summarized below.

COIs Recommended for Further Evaluation

- **TCE, PCE, Chloroform, Vinyl Chloride, and 1,1-DCA:** The HHRA identified TCE, PCE, chloroform, and 1,1-DCA as being present at the site at concentrations that pose unacceptable risks. These chemicals were identified as COIs during the evaluation of the nature and extent of contamination. The RI recommended that an FS be conducted to develop and evaluate remedial alternatives to address risks from exposure to these chemicals.
- **Vinyl Chloride:** The risk assessment identified vinyl chloride as being present at the site in groundwater, soil gas, and sub-slab concentrations exceeding screening levels. Vinyl chloride was not detected in any indoor air sample; however it was present in sub-slab concentrations at concentrations which indicate that it could pose a threat to indoor air. Therefore, although it is not presently a risk driver, vinyl chloride is recommended for further evaluation.

COIs Not Recommended for Further Evaluation

- **Benzene and Ethylbenzene:** There were only two cases where sub-slab samples exceeded the screening level for benzene and no cases where the ethylbenzene exceeded the sub-slab screening level. Where sub-slab and indoor air sample pairs were collected, the indoor air concentration was equal to or greater than the sub-slab concentration in all cases. This pattern indicates that the benzene concentrations found in indoor air are likely due to indoor sources, and are not the result of VI. For VI to be present, the sub-slab concentration would have to be at least 10 times greater than a paired indoor air sample, to account for attenuation.

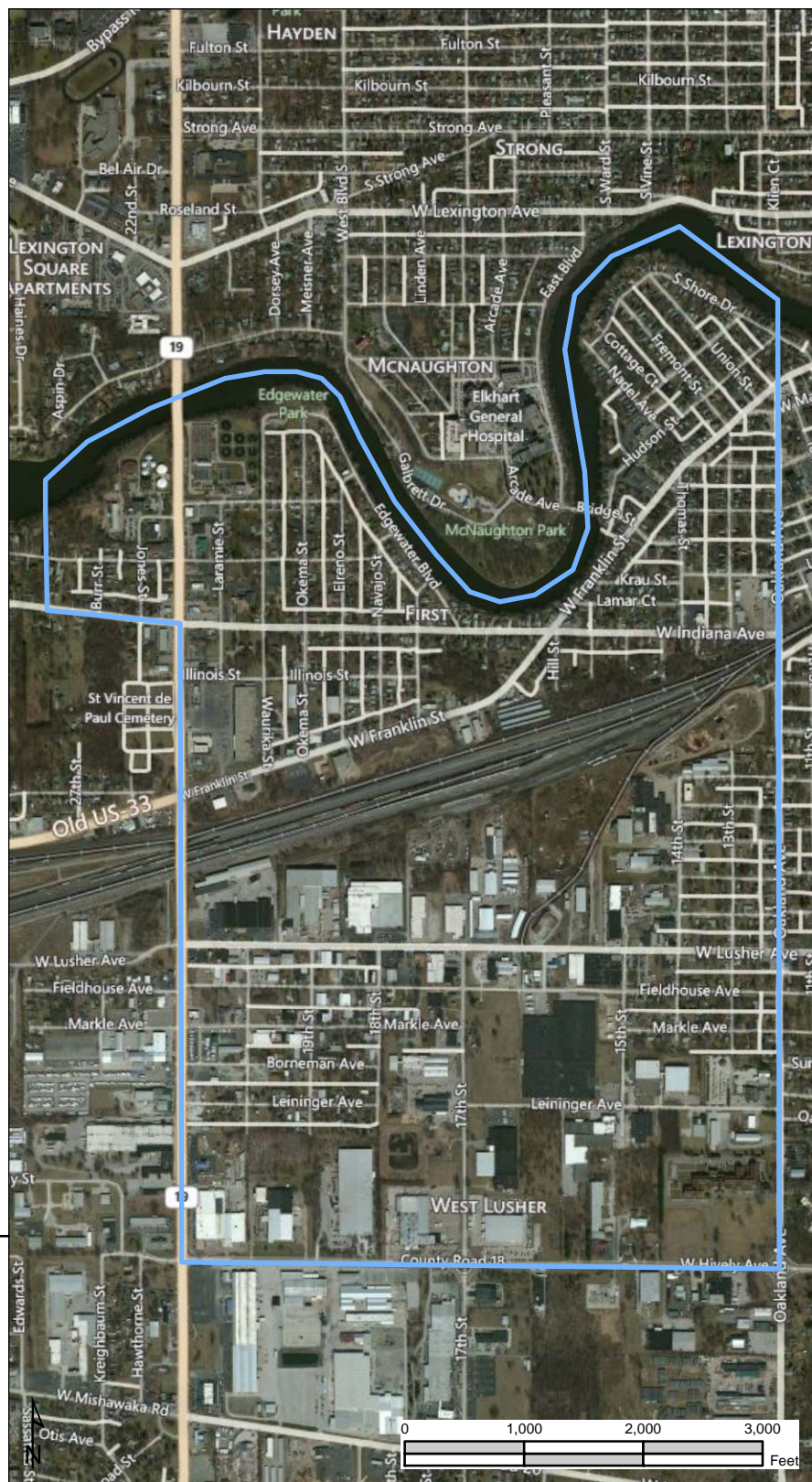
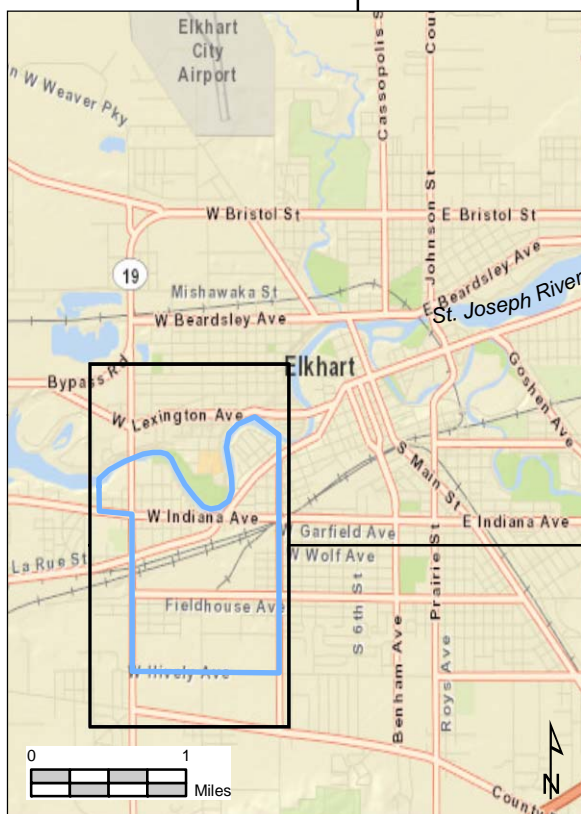
Furthermore, benzene was detected in the RI samples only when at least one other BTEX compound (toluene, ethylbenzene, *o*-xylene, or *m*- and *p*-xylene) also was detected. The same is true of ethylbenzene except for one sample collected from the former Sturgis Metals property in 2009. Additionally, neither benzene nor ethylbenzene was detected in samples collected from the water table during the first step of the VI evaluation. The presence of benzene and ethylbenzene in indoor air samples likely is due to household sources, potentially including petroleum products in vehicles in attached garages, stored in garages or homes, and in household products, or to petroleum vapors from a gasoline station. Benzene and ethylbenzene are not recommended for further evaluation as part of OU 1. Instead, they should be addressed as part of OU 2, Source Control.

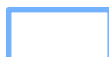
- **1,2,4-Trimethylbenzene:** 1,2,4-Trimethylbenzene was identified in the HHRA as a lesser risk driver for some properties. 1,2,4-Trimethylbenzene was detected extensively in soil gas, sub-slab and indoor air samples but was not detected at all in groundwater. 1,2,4-Trimethylbenzene occurs naturally in coal tar and petroleum, and is a gasoline additive. A possible source for the 1,2,4-trimethylbenzene is gasoline, for which 1,2,4-trimethylbenzene is an additive. Other potential sources are coal tar, which is sometimes used as a driveway sealer.
- **1,2-DCA:** The only detections of 1,2-DCA in groundwater were in samples collected from the former Sturgis Metals property, a PSA. 1,2-DCA was not detected in any groundwater samples collected from the water table. Furthermore, 1,2-DCA was detected in 78 percent of the indoor air samples but in only 37 percent of the sub-slab and 7 percent of the soil vapor samples. Where paired sub-slab and indoor air samples were collected, there were no instances where the sub-slab concentration exceeded the indoor air concentration. The VI pathway for 1,2-DCA is incomplete.

1,2-DCA is not recommended for further evaluation during the FS for OU 1. 1,2-DCA should be addressed as part of OU 2.

- **Methylene Chloride:** Methylene chloride was detected at concentrations exceeding the MCL in groundwater at one location on the former Sturgis Metals property. It was not detected in any groundwater samples collected from the water table. Methylene chloride was not detected in any sub-slab samples at concentrations exceeding the screening levels. Furthermore, methylene chloride was not detected in sub-slab samples at concentrations at least 10 times the indoor air sample results, indicating a likely indoor source. The VI pathway for methylene chloride is incomplete. Methylene chloride is not recommended for further evaluation during the FFS for OU 1. However, methylene chloride is recommended for further evaluation as part of OU 2.
- **cis-1,2-Dichloroethene:** cis-1,2 Dichloroethene (cis-1,2-DCE) was not identified as a risk driver in the HHRA. It was detected in one location, at the former Sturgis property, exceeding MCL values. There are no inhalation toxicity values for cis-1,2-DCE, and therefore no screening levels to which to compare the air and vapor samples. However, there was a low detection frequency in indoor air (< 10%). cis-1,2-DCE is not recommended for further evaluation during the FFS for OU 1. However, cis-1,2-DCE is recommended for further evaluation as part of OU 2.
- **1,4-Dichlorobenzene:** 1,4-Dichlorobenzene was detected in only one VAS sample collected from the former Sturgis Metals property. 1,4-Dichlorobenzene was not detected in any groundwater samples collected from the water table. Although the detection frequency of 1,4-dichlorobenzene was high in indoor air and soil vapor samples (exceeding 75 percent), the VI pathway is incomplete because 1,4-dichlorobenzene was not detected in groundwater in the VI area of concern. A property-by-property review of data indicated that there was only one property (Property No. 25) where 1,4-dichlorobenzene met sub-slab and indoor air criteria for VI; however, the nearby soil gas sample (VISG-15) was non-detect for 1,4-dichlorobenzene. Furthermore, at Property No. 25, 1,4-dichlorobenzene was detected in only one of the three 2012 sampling events, and the sub-slab and indoor air concentrations were below the screening levels outlined in the Region 5 VI guidance. (Other COIs, including TCE, were detected in all three sampling events at Property No. 25). 1,4-Dichlorobenzene is not recommended for further evaluation during the FS for OU 1. 1,4-Dichlorobenzene should be evaluated further as part of OU 2.
- **Carbon Tetrachloride:** Carbon tetrachloride was not retained as a COI from the groundwater evaluation because it was not detected in any groundwater samples. Carbon tetrachloride was detected in soil vapor and sub-slab samples but at concentrations below the screening levels. There were detections of carbon tetrachloride in indoor air samples, but with corresponding sub-slab samples below the screening level, the VI pathway is incomplete and indoor sources are likely present. Carbon tetrachloride is not recommended for further evaluation during the FS for OU 1 or as part of OU 2.
- **1,1,1-TCA:** 1,1,1-TCA was not identified as a risk driver in the HHRA. The only location where 1,1,1-TCA concentrations exceeded screening levels during the RI was at the former Sturgis Metals property. The absence (or comparatively low concentrations) of 1,1,1-TCA in samples collected during this RI was unexpected and suggests that the releases of 1,1,1-TCA that in part (along with identified TCE releases) prompted this RI were relatively limited and apparently have dissipated since the compound was first detected in 1987. There were no sub-slab or indoor air results which exceeded the screening criteria. 1,1,1-TCA is not recommended for further evaluation during the FS for OU 1. However, 1,1,1-TCA is recommended for further evaluation as part of OU 2.

- **Arsenic:** Arsenic was not retained as a COI from the groundwater evaluation because it was not detected at concentrations above the MCL. Of the 21 samples collected, 16 were non-detect for arsenic, and the maximum concentration detected was 2.6 µg/L, approximately one-fourth of the MCL of 10 µg/L. Because of the low detection frequency and low concentrations found, with the maximum detected concentration being below the MCL, arsenic is not recommended for further evaluation.



 Site boundary



LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

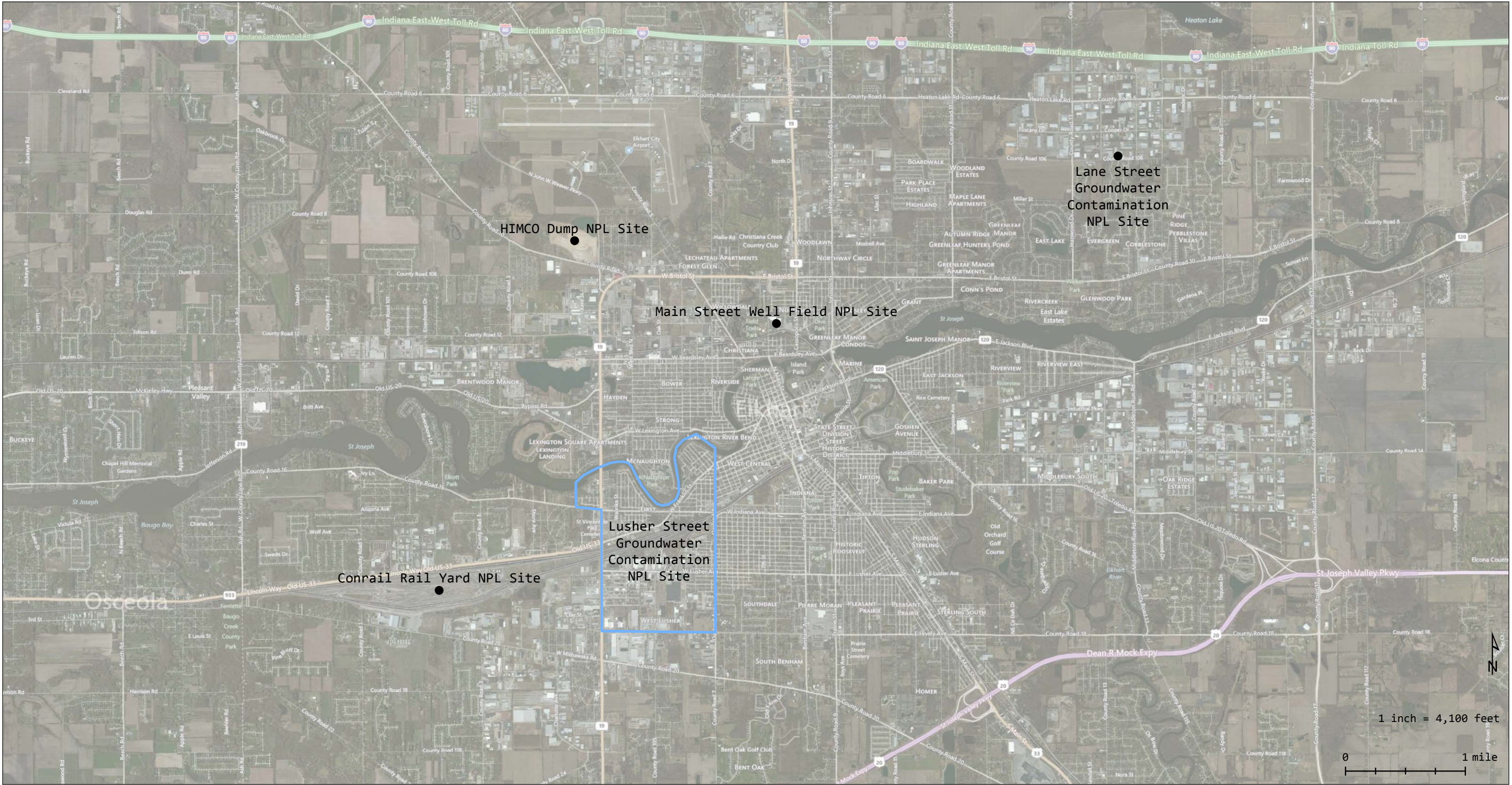
FINAL FOCUSED FEASIBILITY STUDY

FIGURE 1-1

SITE LOCATION MAP

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ST **SuITRAC**



●

NPL site

Lusher Street site boundary

Notes:

ECHD = Elkhart County Health Department
NPL = National Priorities List

LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

FINAL FOCUSED FEASIBILITY STUDY

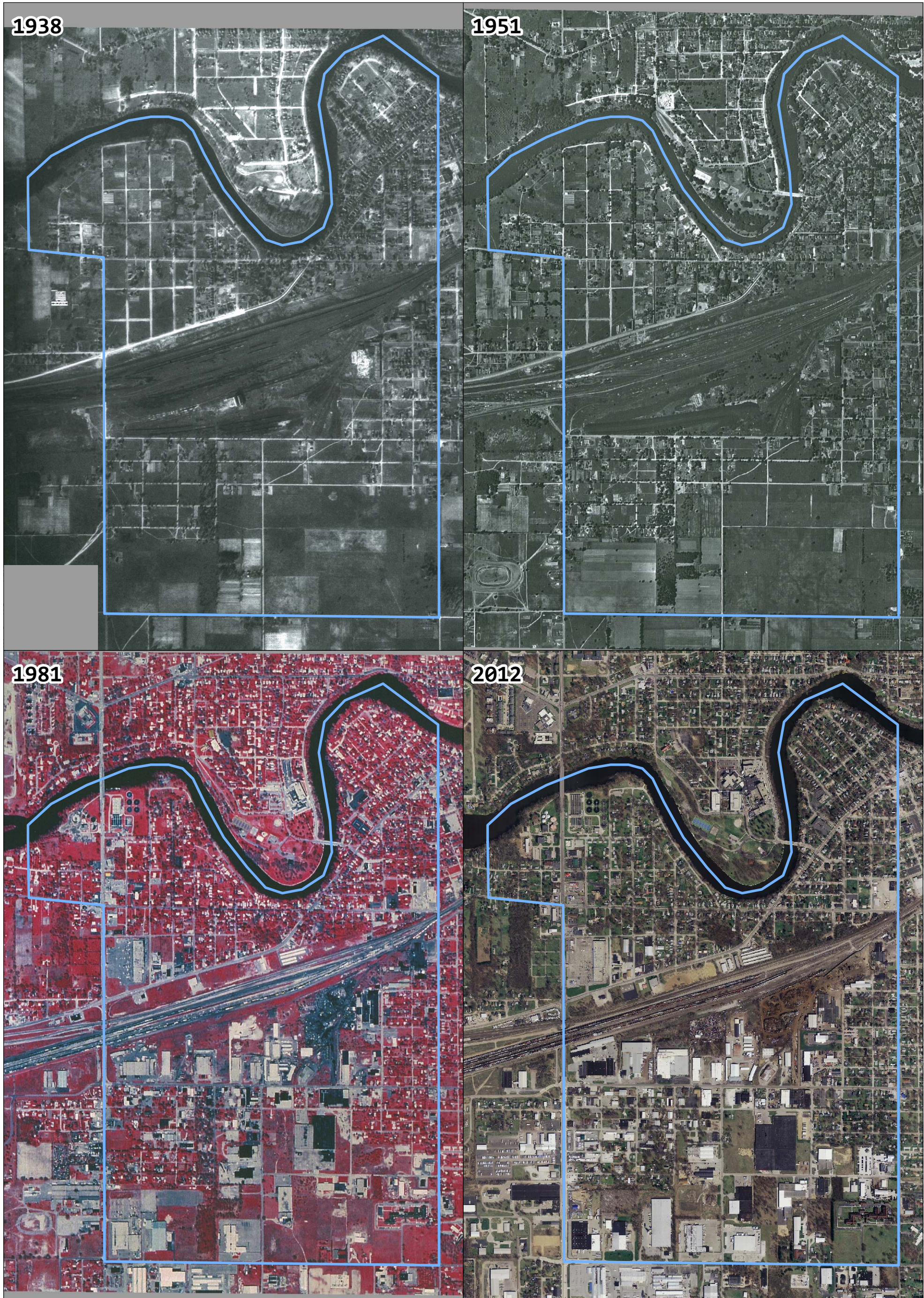
FIGURE 1-2


ELKHART AREA NPL SITES

EPA REGION 5 RAC 2 | REVISION 0 | SEPTEMBER 2013

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SuITRAC



 Site boundary

Scale bar and scale text are approximate
for the 1938, 1951 and 1981 maps.

1 inch = 1,350 feet

0 0.5 1 mile



LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

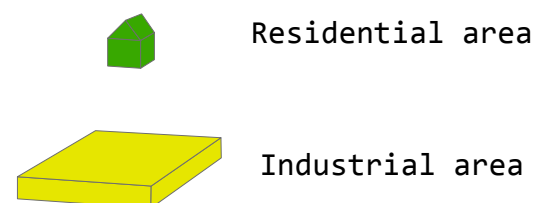
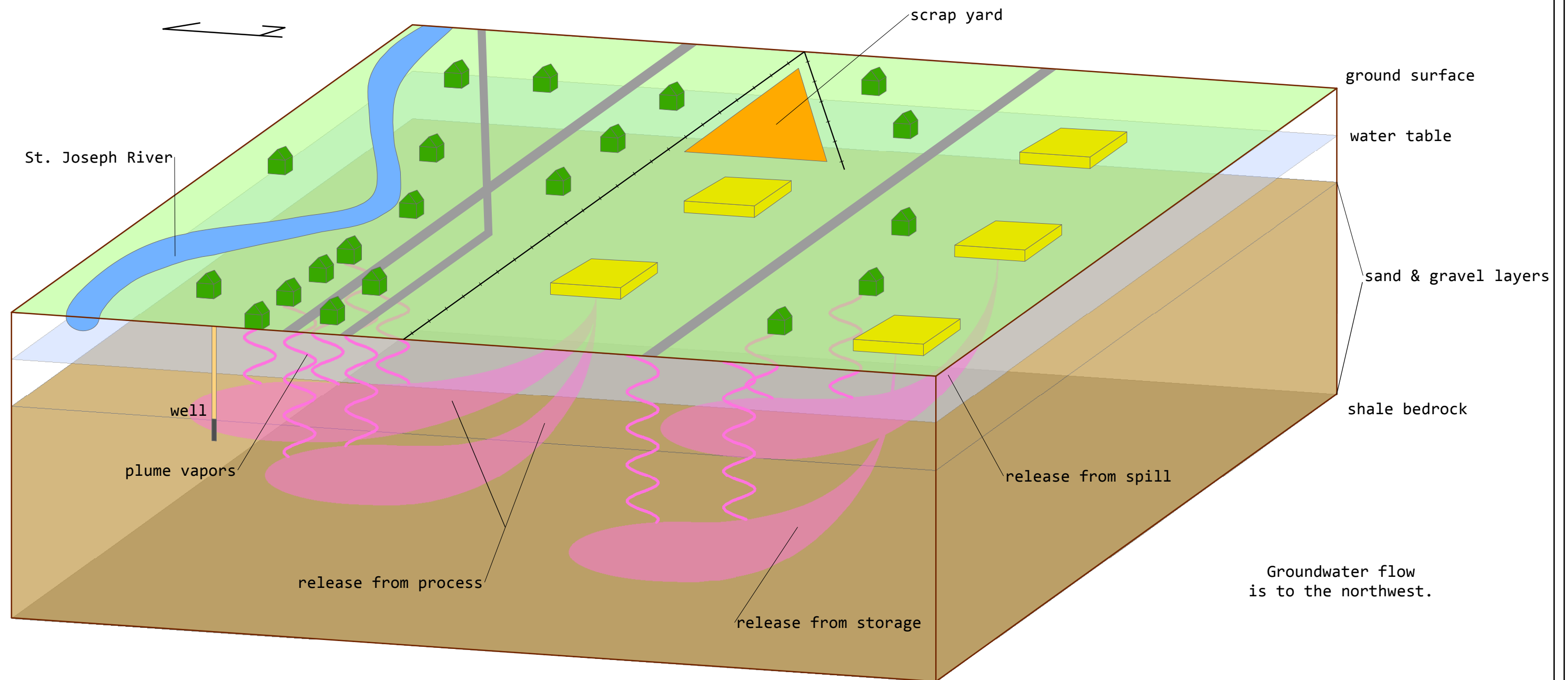
FINAL FOCUSED FEASIBILITY STUDY

FIGURE 1-3

HISTORICAL AERIAL PHOTOGRAPHS

EPA REGION 5 RAC 2 | REVISION 0 | SEPTEMBER 2013

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2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section presents the regulatory framework supporting this FFS and discusses the remedial objectives (Section 2.1); ARARs at the federal, state, and local levels (Section 2.2); RAOs to protect human health (Section 2.3); the proposed RALs (Section 2.4); proposed interim remedial areas for groundwater and VI (Section 2.5); GRAs (Section 2.6); and the identification and screening of technology types (Section 2.7).

2.1 REMEDIAL OBJECTIVES

The process of identifying and screening technologies begins with the creation of the remedial objectives. The remedial objectives of the FS process include the ARARs, RAOs, and RALs.

CERCLA specifies that Superfund remedial actions must meet any federal standards, requirements, criteria, or limitations determined to be legally ARARs. Also included is the provision that state ARARs must be met if they are more stringent than federal requirements (EPA 1988). For the Lusher Site, the RAOs consist of goals for protecting human health from exposure to contaminated groundwater and related VI. The RALs will be provided in the Proposed Plan and/or the Interim ROD for OU 1. The RALs will be selected based on site-specific risks and hazards from the HHRA and SLERA presented in the Final RI report, along with a review of the ARARs, and will be consistent with the NCP.. Together, the ARARs, RAOs, and RALs create the site-specific “regulatory” framework for the remedial action and for the final remedy to achieve. The ARARs, RAOs, and RALs are discussed in detail in the following sections.

2.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Regulatory requirements, standards, and guidance are referred to as ARARs. ARARs depend on the detected contaminants, site-specific characteristics, and particular remedial actions proposed for the Site. This section discusses the identification of ARARs for OU 1 of the Lusher Site.

Under Section 121(d)(1) of CERCLA, remedial actions must be protective of human health and the environment. Additionally, CERCLA remedial actions must meet a level and standard of control that attains standards, requirements, limitations, or criteria that are “applicable or relevant and appropriate” under the circumstances of the release. These requirements are derived from federal and state laws and are known as ARARs. Federal, state, or local permits are not necessary for removal or remedial actions implemented under a CERCLA remedial action, but applicable substantive requirements of the permits must be met.

The NCP (Title 40 of the *Code of Federal Regulations* [CFR] 300.5) defines “applicable requirements” as

“...those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.”

The NCP (40 CFR 300.5) defines “relevant and appropriate requirements” as

“...those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.”

State requirements identified in a timely manner and that are more stringent than corresponding federal requirements may be applicable or relevant and appropriate. Three types of ARARs have been identified on a site-specific basis for the Lusher Site: chemical-, location-, and action-specific ARARs. Each type of ARAR is briefly described below.

Chemical-specific ARARs are health- and risk-based numerical values and methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values and methodologies (such as promulgated standards and risk assessments, respectively) establish acceptable concentrations of a chemical contaminant that may remain in the environment.

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because the site-specific location is of environmental importance.

Action-specific ARARs are technology- or activity-based requirements or limitations on actions to be taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities selected to accomplish a remedy.

As part of the FFS, potential federal, state, and local ARARs were identified. [Table 2-1](#) summarizes the specific ARARs identified as “to be considered,” “potentially applicable,” and “relevant and appropriate” for groundwater and VI at OU 1.

2.3 REMEDIAL ACTION OBJECTIVES

RAOs are goals specific to media or OUs for protecting human health and the environment. Risk can be associated with current or potential future exposures. RAOs should be as specific as possible but not so specific that the range of alternatives to be developed is unduly limited. Objectives aimed at protecting human health and the environment should specify (1) COCs, (2) exposure routes and receptors, and (3) an acceptable contaminant level or range of levels for each exposure route (that is, RALs) (EPA 1988).

The Final Lusher Street RI HHRA identified the following receptors: current and future residents, current and future industrial/commercial workers, current and future utility and construction workers, and current and future recreationalists. Section 7.2 of the RI report details the exposure routes for each receptor (SulTRAC 2013). Current land uses within OU 1 include residential, recreational, and industrial / commercial properties. For the purposes of the HHRA, future land uses of all properties were assumed to be the same as current land uses. In addition to the primary types of receptors associated with each property (for example, adult and child residents at residences), the risk assessment also considered potential exposures of workers involved in utility installation and repair and construction activities at each property (SulTRAC 2013).

The NCP requires that a range of excess lifetime cancer risks of (1×10^{-4} to 1×10^{-6} excess lifetime cancer risk) be evaluated, using 10^{-6} as a point of departure (EPA 1994). Non-cancer risks are to be limited to levels to which human populations, including sensitive sub-groups, may be exposed without adverse effect during a lifetime. This translates into a HI not exceeding 1.

The proposed interim RAOs for OU 1 are as follows:

- **RAO 1:** Protection of human health from chemical risks and hazards by preventing actual or potential direct exposure to or potable use of groundwater containing COCs at levels resulting in unacceptable risk for current and future Site users, specifically current and future residents, industrial / commercial workers, utility workers, and construction workers
- **RAO 2:** Protection of human health from chemical risks and hazards posed by VI associated with groundwater contamination for current and future Site users, specifically residents and industrial / commercial workers, utility workers, and construction workers

2.4 REMEDIAL ACTION LEVELS

RALs are COI concentrations used during the analysis and selection of remedial alternatives and during the remedial design and remedial action processes. The RALs are used to estimate the extent of contamination requiring remedial action. The residual risks (including both carcinogenic risks and non-

carcinogenic hazards) comply with the NCP requirements for protection of human health and the environment. The RALs apply to residential and industrial / commercial property uses. During the RI and this FFS, residences, recreational parks, schools, and churches are assessed as residential areas. Industrial / commercial areas include businesses, industrial properties, rights-of-way, and easements.

The RALs will be provided in the Proposed Plan and/or the Interim ROD for OU 1. The RALs will be selected based on site-specific risks and hazards from the HHRA and SLERA presented in the Final RI report, along with a review of the ARARs, and will be consistent with the NCP. Table 2-2 provides a summary of some of the key values which may be used in selecting the RALs. For the purposes of this FFS, Sections 2.5.1 and 2.5.2 will describe the proposed interim remedial areas. During the remedial design phase, these areas may be revised based on the ROD and new information.

While the RALs will be used to identify potentially unacceptable current exposures for purposes of the interim remedial actions, the interim remedial actions, especially with respect to groundwater, may not necessarily assure long-term compliance with the RALs. The interim actions are intended to address current threats in the short term. The final remedy for OU1 will be selected in a subsequent ROD after source areas in OU2 are fully characterized and addressed.

2.4.1 Attribution to Vapor Intrusion

Attribution to VI is an important part of determining the RALs. This section presents a proposed attribution approach for initial use. EPA may modify this approach at a later date. Indoor air concentrations are a combination of several components: vapor intrusion, ambient air, and household sources. Contributions from ambient air are expected to be very low, based on sample results from outdoor air. While they must be taken into account, CERCLA typically does not remediate household sources. The Region 5 Vapor Intrusion Guidance provides guidance in evaluating sites for potential vapor intrusion, and the upcoming Office of Solid Waste and Emergency Response (OSWER) Vapor Intrusion Guidance (presently in an External Review Draft stage) is expected to provide further guidance.

2.5 PROPOSED INTERIM REMEDIAL AREAS

This FFS considers interim alternatives. Potential additional long term alternatives will be evaluated separately once the source areas have been identified and remediated. This approach was selected because EPA is presently in the process of identifying potential sources and potentially responsible parties for the Site. Available information indicates multiple sources of contamination. For a long-term remedy to be

successful, the sources require identification and control. Interim alternatives are designed to control actual or potential risk from current exposure pathways in the near term.

The following sections discuss the proposed Interim Groundwater and Interim VI Remedial Areas.

2.5.1 Proposed Interim Groundwater Remedial Areas

The purpose of the RI at OU 1 was to evaluate the nature and extent of contamination in groundwater and the associated VI pathway to assess associated human health risks. Although during the RI only 2 of the 54 residential wells sampled contained COIs at concentrations exceeding the MCLs and RALs, historical results indicate that more residential wells at the Lusher Site were contaminated.

Previous removal actions have resulted in the installation and maintenance of filters and the connection of municipal water to multiple addresses. The Interim Groundwater Remedial Areas consist of all properties currently occupied and not connected to a municipal water supply, located within the plume area (with an approximate 500-foot buffer), or potentially downgradient of the plume. Two areas have been excluded. The first of these, the northeast portion of the site, is shown on [Figure 2-1](#). This area of the site has not had contamination detected and is located cross- or upgradient from the plume. The second area is located in the southeast portion of the site. This area is upgradient of the plume. [Figure 2-1](#) shows these properties and the areas where municipal water is not available. Currently, it is estimated that, within the proposed interim groundwater remedial area, 72 properties with buildings on them are not connected to municipal water. The number of properties with buildings requiring connection to municipal water is based on (1) geographic information system (GIS) data obtained from Elkhart County and (2) a list of addresses with water accounts obtained from the City of Elkhart Public Works Department. The actual number may vary as buildings are condemned, demolished, abandoned, or constructed.

2.5.2 Proposed Interim Vapor Intrusion Remedial Area

During the RI, the VI exposure pathway (groundwater contaminated with VOCs that volatilize and travel through soil and migrate into buildings) was investigated and determined to be complete. A TCE VI area of concern was identified. Within this area, sample results indicate that there is a potential for VI from site-related contamination to cause indoor air concentrations to exceed the 1×10^{-6} additional cancer risk point of departure set by the NCP. [Figure 2-2](#) shows this area, which is the proposed Interim VI Remedial Area. This area is roughly centered on the intersection of West Indiana Avenue and West Franklin Street. Within this area, available data indicate 196 buildings.

Because VI is very property-specific and conditions can change over time, additional sampling is required during the remedial design and/or remedial action phase to determine the specific properties that will require mitigation. The number of properties requiring mitigation used in this FFS report is based on the percentage of properties sampled during the RI with a potentially complete or complete VI pathway. The actual number may vary as properties are condemned, demolished, abandoned, or constructed. Currently it is estimated that approximately 127, or 65%, of the buildings will meet the requirements for mitigation, based on Region 5 guidance. This number is extrapolated from the RI and is based on three rounds of sampling (45% met the criteria for mitigation in at least one round of sampling; a further 40% would require additional monitoring; half of these are assumed to require mitigation; and 15% met the requirements for no further action). Note that a decision may be made to proactively mitigate all of the buildings within the VI area, rather than having to perform continued sampling. Additionally, the Region 5 VI guidance is based on a 1×10^{-5} additional cancer risk, which is within the range which can, but does not necessarily require, mitigation as indicated in the NCP.

2.6 GENERAL RESPONSE ACTIONS

GRA are broad categories of possible remedial actions, such as containment or removal. Technologies are separated into GRA categories. Potential technologies are evaluated to identify those that may be capable of achieving the RAOs. The established performance of each technology with regard to Site contaminants and conditions is considered during the identification and screening process, when potential technologies are evaluated based on effectiveness, implementability, and cost. The GRAs are then used to identify specific remedial technologies that may be implemented at the Site.

This section presents the GRAs developed to achieve the proposed RAOs discussed in [Section 2.3](#). [Table 2-3](#) lists the groundwater and VI GRAs, which include the following:

- No Action
- Institutional Controls (IC)
- VI Pathway Restriction (i.e., VI mitigation)
- Alternate Water Supply or Protection

2.7 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES

Although this FFS is directed at identifying only interim remedial alternatives, this section discusses the identification and screening of interim remedial technologies proposed for the remediation of OU 1. The

identification and screening were performed using the processes outlined in the EPA's RI/FS guidance (EPA 1988) and the NCP (EPA 1994). First, technologies that may be capable of attaining the proposed RAOs discussed in Section 2.3 were identified. During technology identification, the demonstrated performance of each technology with regard to Site contaminants and conditions was considered. Categories of remedial technologies were identified based on a review of literature, vendor information, performance data, and experience in developing other FSs under CERCLA. Technologies considered potentially applicable to achieving the RAOs were selected for screening. The technology screening process reduced the number of potentially applicable technologies by evaluating factors that may influence process-option effectiveness and implementability. This overall screening was consistent with guidance for performing FSs under CERCLA (EPA 1988). The purpose of the screening was to reduce the number of technologies chosen to assemble the remedial alternatives discussed in Section 3.0.

During the screening process, each technology was assessed with regard to its probable effectiveness, implementability, and cost with regard to site-specific conditions, site-related contaminants, and affected environmental media. The short- and long-term effectiveness evaluation focused on (1) whether the technology is capable of handling the estimated areas or volumes of media and meeting the goals identified in the RAOs, (2) the effectiveness of the technology in protecting human health and the environment during the construction and implementation phases, and (3) how proven and reliable the technology is with respect to contaminants and conditions at the Site. In accordance with EPA guidance, to evaluate effectiveness, the "short term" was considered to be the remedial construction and implementation period and "long term" was considered to begin once the remedial action was complete and RAOs have been achieved (EPA 1988).

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. Technical feasibility was evaluated based on the ability to construct, reliably operate, and meet regulations as well as the ability to meet operation and maintenance (O&M), replacement, and monitoring requirements after completion of the remedial action. Technical implementability was assessed to conduct an initial screening of technology types to eliminate those that are clearly ineffective or unworkable at the Site. Technical implementability was evaluated to verify that a technology is applicable to the Site. Administrative feasibility was evaluated based on the ability to obtain necessary permits for off-site actions; the ability to obtain approvals from other agencies; the availability of treatment, storage, and disposal services (including capacity); and the availability of equipment and skilled workers to implement the technology. For technology screening purposes, implementability was categorized into three levels: easy to implement, implementable, and difficult to implement.

Cost played a limited role in the screening of technologies. The objective of the cost evaluation was to eliminate from further consideration technologies with grossly excessive costs for the effectiveness provided. The cost evaluation was accurate enough to support decisions about which technologies to retain. Relative capital and O&M costs rather than detailed quantitative estimates were considered during the screening step. At this stage in the process, the cost analysis was based on engineering judgment, and each technology was evaluated with regard to whether costs are high, low, or moderate relative to other technology options for the same medium (EPA 1988). The relative cost for each technology was estimated in terms of general technology cost, not site-specific cost. Quantitative cost estimates were developed later during the FFS process as a part of the detailed analysis of alternatives discussed in [Section 4.0](#) for alternatives that passed the screening process.

A two-step process was used to screen the technologies. The initial step was to identify a wide range of potential technologies based on past experience and general knowledge of remedial options. The second step was to conduct the initial screening of these technologies as described above. The product of this effort is a list of retained technologies to be considered when developing potential remedial alternatives to be carried forward to the FFS alternatives evaluation process.

[Table 2-4](#) summarizes the identified candidate technologies for risk mitigation at OU 1 of the Lusher Site, including a list of candidate technologies, a brief description of each technology, and specific comments on the application of the technology. The following candidate technologies (separated by GRA) were identified for OU 1:

- No Action
 - No Action
- ICs
 - Groundwater use restrictions
 - Property access and/or use restrictions
- Alternate Water Supply or Protection
 - Whole-house treatment system
 - Point-of-use treatment system
 - Alternate water supply - bottled water
 - Alternate water supply - municipal water
- VI Pathway Restriction
 - Passive barrier and venting
 - Passive venting

- Sub-slab depressurization (SSD)
- SSD and passive barrier
- Building pressurization
- Indoor air treatment

The following sections discuss the candidate technology screening and the retained candidate technologies.

2.7.1 Candidate Technology Screening

The groundwater and VI potential candidate technologies identified in [Table 2-4](#) were screened for effectiveness, implementability, and cost as described above based on the COIs for OU 1. [Table 2-5](#) presents the results of this screening effort, including assessment of effectiveness, implementability, and relative cost of each identified technology. The table also notes whether the technology was retained and, if not, the specific reason for elimination. Because the source areas have not all been identified or addressed, technologies which may be suitable for long term use in treating the groundwater are not retained in this FFS report. The technologies which have been retained are those that are suitable for use as interim alternatives, i.e., can rapidly prevent or mitigate exposure to contaminants.

It should be noted that the screening presented in [Tables 2-4 and 2-5](#) is the screening of technologies as primary remedial mechanisms. However, even if a technology is eliminated as a primary remedial mechanism, it may still be a part of an overall approach.

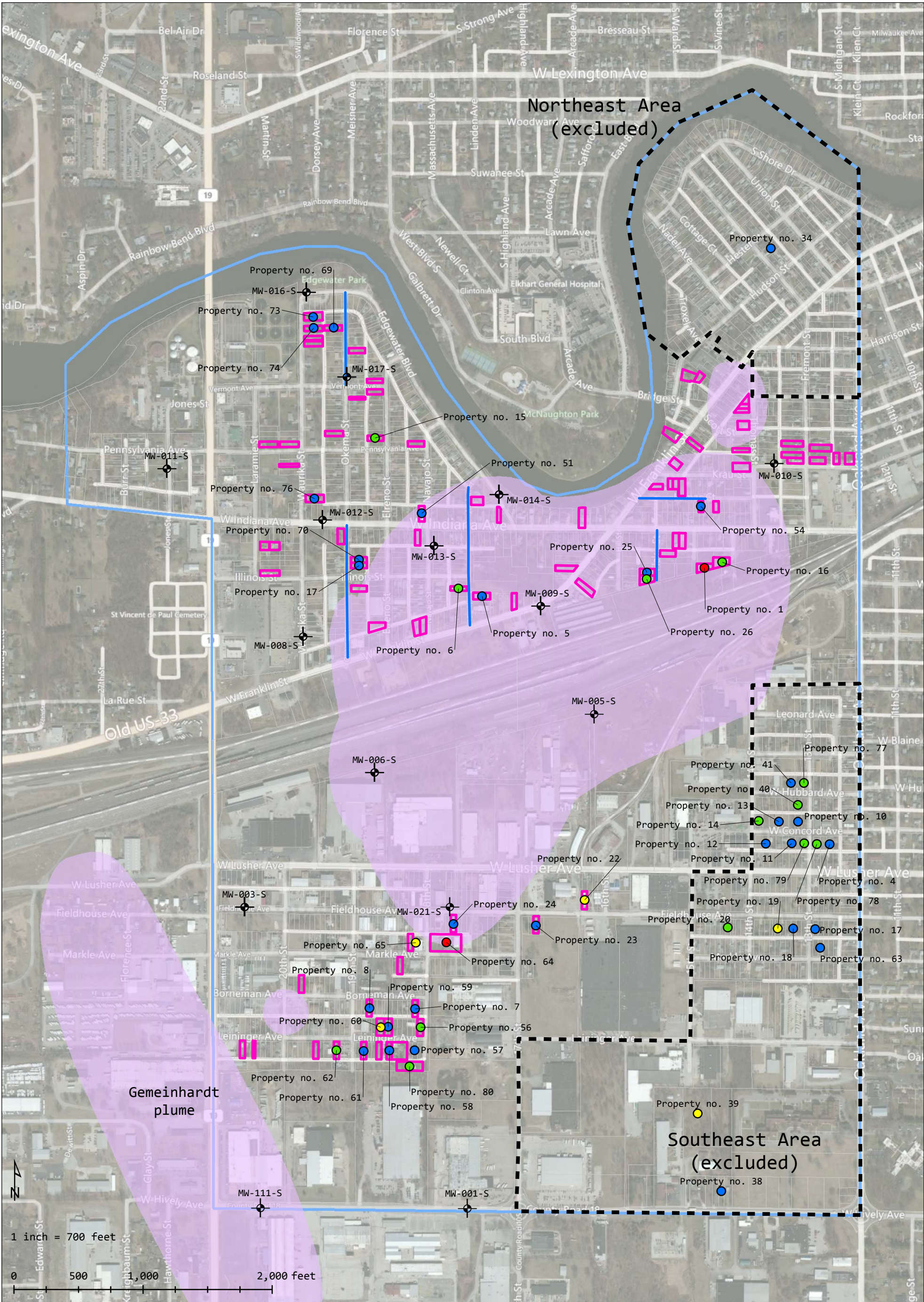
2.7.2 Retained Candidate Technologies

[Table 2-6](#) presents the potential interim remedial technologies still under consideration for mitigation of identified risks from current exposure pathways associated with OU 1 of the Lusher Site. The tables also include comments on the potential application of each technology at OU 1. The following GRAs and technologies were retained for interim use ([Table 2-6](#)):

- No Action
 - No Action
- ICs
 - Groundwater use restrictions
 - Property access and use restrictions
- Alternate Water Supply or Protection
 - Whole-house treatment system
 - Point-of-use treatment system

- Alternative water supply - municipal water
- VI Pathway Restriction
 - SSD
 - SSD and passive barrier
 - Building pressurization

The retained technologies listed in [Table 2-6](#) are the building blocks used to develop the potential remedial alternatives discussed in [Section 3.0](#) of this FFS report. These alternatives are capable of providing interim mitigation of actual or potential exposures.



Monitoring well

VOC detected above MCL

VOC detected above RSL

VOC detected below RSL & MCL

No VOCs detected

Proposed water-main

Property without a water account

Site area excluded from interim groundwater remedial area

Composite plume

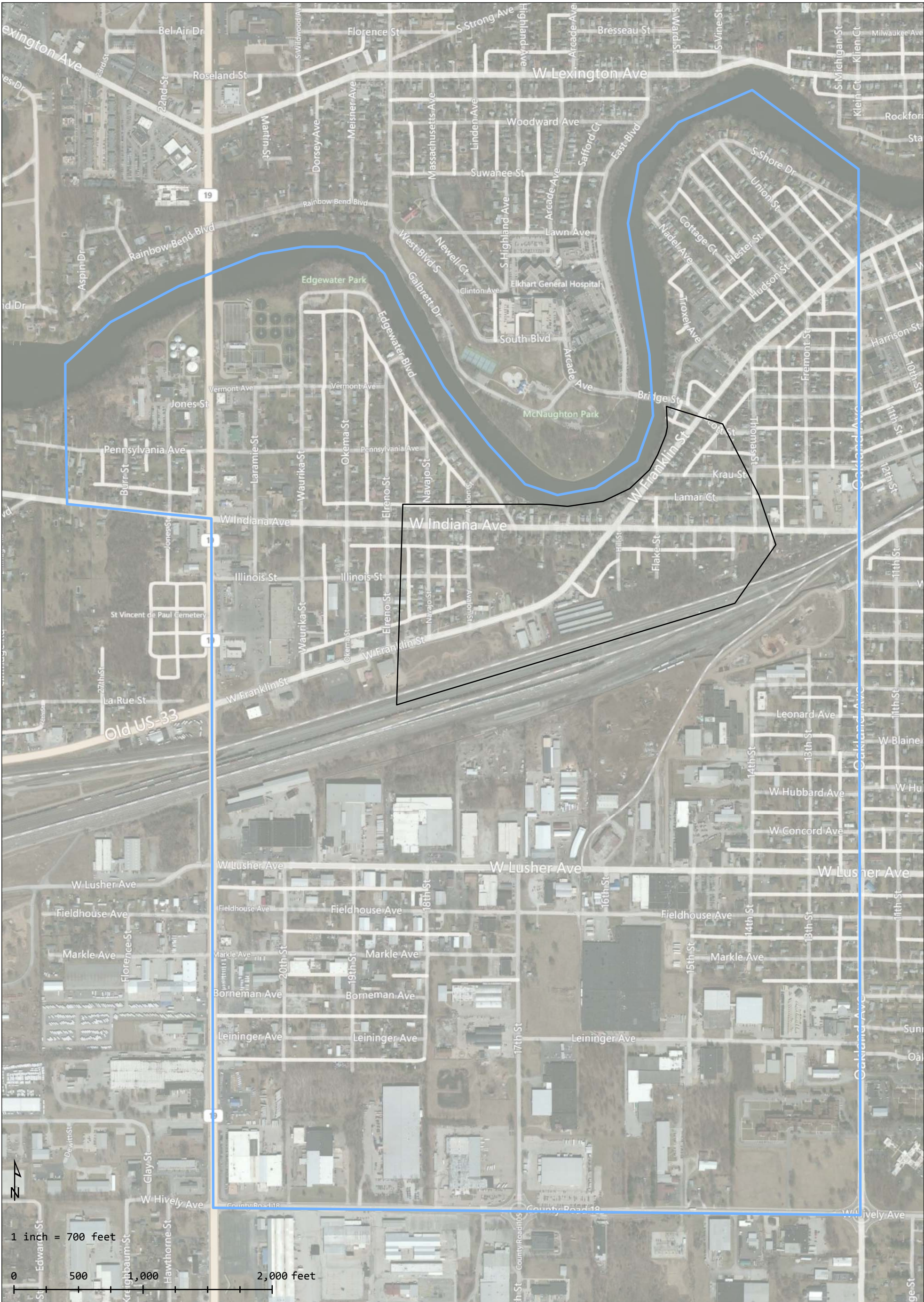
Parcel

Site boundary

Notes:
MCL = Maximum Contaminant Level
RSL = Regional Screening Level
VOC = Volatile Organic Compound

LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA
FINAL FOCUSED FEASIBILITY STUDY
FIGURE 2-1
PROPERTIES & AREAS NOT ON MUNICIPAL WATER
(INTERIM GROUNDWATER REMEDIAL AREAS)
EPA REGION 5 RAC 2 | REVISION 0 | SEPTEMBER 2013

SuITRAC



TCE vapor intrusion area of concern

Site boundary

LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

FINAL FOCUSED FEASIBILITY STUDY

FIGURE 2-2

INTERIM VI REMEDIAL AREA

EPA REGION 5 RAC 2 | REVISION 0 | SEPTEMBER 2013

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SuITRAC

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
SAFE DRINKING WATER ACT OF 1974				
40 CFR Parts 141.60 – 141.63 and 141.50 – 141.52	The National Primary Drinking Water Regulations establish MCLs and MCLGs for several common organic and inorganic contaminants for public drinking water systems. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentrations at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable, health-based goals set equal to or lower than MCLs.	Chemical-specific	Relevant and appropriate	These regulations apply to all public water supplies (having more than 15 connections or serving more than 25 persons regularly). The MCLs are the ARARs for the Site because the aquifer currently is used for drinking water at residences not hooked up to the alternate water supply during previous Site investigations. Currently, nothing prohibits the use of groundwater at the Site as a public water supply (for example, supplying an apartment building with 25 or more residents) or in a small water supply system.
FLOODPLAIN MANAGEMENT EXECUTIVE ORDER 11988				
40 CFR Part 6, Appendix A	This order requires federal agencies to evaluate potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification or construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	Location-specific	Potentially Applicable	This order is applicable to construction activities in the St. Joseph River floodplain.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
CLEAN WATER ACT OF 1977				
Protection of Wetlands, Executive Order 11990 (40 CFR Part 6, Appendix A)	Under this order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values of the wetland areas.	Location-specific	Potentially applicable	This order may be applicable or relevant and appropriate depending on the location of wetlands, if any, along the St. Joseph River. No wetlands currently are known to exist along the northern Site boundary or the St. Joseph River.
NPDES, 33 USC, §§ 1251-1387, Clean Water Act NPDES Permit Program (40 CFR 122)	Under this program, discharges of pollutants to waters of the United States are regulated.	Action-specific and possibly chemical-specific	Potentially applicable	Applicability depends on the remedial action chosen. Program requirements apply to extracted groundwater discharged to waters of the U.S.
Federal Water Pollution Control Act, Section 401: Water Quality Certification	This requirement establishes a permit program to regulate discharge into waters of the United States, including wetlands.	Chemical-specific	Potentially applicable	Applicability depends on the remedial action chosen.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
FISH AND WILDLIFE COORDINATION ACT				
16 USC, §§ 661 et seq. 16 USC § 742a 16 USC § 2901 40 CFR 6.302 50 CFR 402	Actions that affect species or habitat require consultation with the U.S. Department of the Interior, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state agencies as appropriate to ensure that the proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Consultation with the responsible agency also is strongly recommended for on-site actions. Under 40 CFR Part 300.38, these requirements apply to all response activities under the NCP.	Location-specific	Potentially applicable	Applicability will be further assessed during the FFS.
RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 (RCRA)				
40 CFR 260 – 268	This act includes regulations and requirements for generators, transporters, or owners or operators of treatment, storage, or disposal facilities that use hazardous waste materials.	Chemical-specific	Potentially applicable	Applicability depends on the remedial action chosen. Regulations apply to on-site activities related to the disposal of investigation-derived wastes and to remedies that generate waste, such as excavation performed to install a remedial system.
ENDANGERED SPECIES ACT				
16 USC § 1531 50 CFR 200	This act requires federal agencies to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or adversely modify critical habitat.	Location-specific	Potentially applicable	No endangered species that would be affected by remedial actions are known to be present at the Site.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
NATURAL HISTORIC PRESERVATION ACT				
16 USC §§ 661 et seq. 36 CFR Part 65	This act establishes procedures to provide for preservation of scientific, historical, and archaeological data that could be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. If scientific, historical, or archaeological artifacts are discovered at the Site, work in the area of the Site affected by such discovery will be halted pending completion of any data recovery and preservation activities required pursuant to the Act and any implementing regulations.	Location-specific	Potentially applicable	No part of the Site is listed on the National Register of Historic Places. This Act is potentially applicable during remedial activities if scientific, historic, or archaeological artifacts are identified during implementation of the remedy.
U.S. DEPARTMENT OF TRANSPORTATION				
Requirements for the Transport of Hazardous Materials (40 CFR 172)	Transportation of hazardous materials on public roadways must comply with these requirements.	Action-specific	Potentially applicable	If hazardous materials are transported on or off the Site as part of a remedial action, these regulations apply.
OTHER FEDERAL GUIDELINES TO BE CONSIDERED				
IRIS (EPA 2012)	Risk reference doses are estimates of daily exposure levels unlikely to cause significant adverse non-cancer health effects over a lifetime. Cancer slope factors are used to compute the incremental cancer risk from exposure to Site contaminants and represent the most up-to-date information on cancer risk from EPA's Carcinogen Assessment Group.	Chemical - specific	To be considered	Applicability or relevance and appropriateness will be further assessed and may be used in establishing RALs in the proposed plan and/or ROD.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
EPA RSLs	EPA RSLs and associated guidance necessary to calculate them are risk-based tools for evaluating and cleaning up contaminated sites. The RSLs represent agency guidelines and are not legally enforceable standards.	Chemical-specific	To be considered	Applicability or relevance and appropriateness will be further assessed during the FS.
Clean Air Act	Fugitive emissions from construction sites.			
Underground Injection Control (40 CFR 144-147)	These regulations protect groundwater sources of drinking water by imposing restrictions on underground injections.	Action-specific	Potentially applicable	Groundwater remedial action may require injections, depending on the remedial action chosen.
INDIANA ADMINISTRATIVE CODE (IAC)				
Indiana Drinking Water Standards (327 IAC 2-11 and 8)	These rules establish MCLs in accordance with the Safe Drinking Water Act (40 CFR 141.11) as well as groundwater classification methods and associated standards.	Chemical-specific	Applicable	These regulations apply to all public water supplies (having more than 15 connections or serving more than 25 persons regularly). The MCLs are the ARARs for the Site because the aquifer currently is used for drinking water at residences not hooked up to the alternate water supply during previous Site investigations. Currently, nothing prohibits the use of groundwater at the Site as a public water supply (for example, supplying an apartment building with 25 or more residents) or in a small water supply system.
Regulation of Water Well Drilling (IC 25-39-4 and 312 IAC 13)	This regulation outlines requirements for construction and abandonment of groundwater wells for non-personal use in Indiana.	Action-specific	Potentially Applicable	Installation and abandonment of water wells (such as extraction and monitoring wells) may be required, depending on the remedial action chosen.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
Indiana Solid Waste Rules (IAC Title 329)	These rules apply to remedies that involve off-site disposal of materials typically involved with excavations. Contaminated soil and waste excavated for off-site disposal must be tested for hazardous waste characteristics, and if the soil or waste is found to be hazardous waste, the rule requirements apply.	Action-specific	Potentially applicable	Applicability depends on the remedial action chosen. Regulations apply to on-site activities related to the disposal of investigation-derived wastes and to remedies that generate waste, such as excavation performed to install a remedial system.
Indiana Air Pollution Control Regulations (IAC Title 326)	This law applies to the regulation of air emissions for activities that could create dust (such as excavation).	Action-specific	Potentially relevant and appropriate	Relevancy and appropriateness depend on the remedial action chosen.
RISC	RISC is IDEM's method for developing remediation objectives (risk-based and site-specific) for contaminated soil and groundwater. These remediation objectives protect human health and take into account Site conditions and land use. The RISC document is a non-rule policy.	Chemical-specific	To be considered	The RISC document provides a methodology for establishing remedial goals and determining that remediation has been achieved. The RISC policy does not apply to Superfund sites but does apply to remedial sites under several state programs, including the state version of RCRA, the state Leaking Underground Storage Tank program, the State Cleanup Program (state equivalent of the federal Superfund Program), and the Voluntary Remediation Program.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
Voluntary Remediation of Hazardous Substances and Petroleum (IC 13-25-5)	IC 13-25-5 established the Voluntary Remediation Program in 1993 and gave the IDEM the authority to establish guidelines for voluntary site closure. Under this authority, IDEM developed the RISC non-rule policy document to guide site closures within the authority of IDEM's remediation programs. The RISC guidance document does not have the effect of law.	Chemical-specific	To be considered	The RISC document provides a methodology for establishing remedial goals and determining that remediation has been achieved. The RISC policy does not apply to Superfund sites but does apply to remedial sites under several state programs, including the state version of RCRA, the state Leaking Underground Storage Tank program, the State Cleanup Program (state equivalent of the federal Superfund Program), and the Voluntary Remediation Program.
Indiana Regulations for Establishing Emissions Levels for VOCs (326 IAC 2,8, and 20)	326 IAC establishes permitting requirements for emissions of VOCs and requires Best Available Control Technology for new sources with potential emissions exceeding a specified threshold value.	Action-specific	Potentially applicable	Applicability of substantive requirements depends on the remedial action chosen. Regulations apply to remedies involving the discharge of VOCs.
Indiana Regulations for Permitting of Air Strippers (326 IAC 2 and 8)	326 IAC establishes permitting requirements for emissions of VOCs and requires Best Available Control Technology for new sources with potential emissions exceeding a specified threshold value.	Action-specific	Potentially applicable	Applicability of substantive requirements depends on the remedial action chosen. Regulations apply to remedies involving the use of air strippers to remove VOCs from groundwater.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
Indiana Regulations for Construction Permits for Water Treatment Facilities (327 IAC 3)	The regulations control the issuance of permits for the construction of water pollution treatment or control facilities.	Action-specific	Potentially applicable	Applicability of substantive requirements depends on the remedial action chosen.
Indiana NPDES Permit Regulations (327 IAC 5 and 327 IAC 2)	These regulations apply to NPDES discharges and applicable permits. The regulations represent Indiana's implementation of the federal NPDES permit program.	Action-specific	Potentially applicable	Applicability of substantive requirements depends on the remedial action chosen. Regulations apply to remedies involving discharge to waters of the State, such as the St. Joseph River.
Indiana Wellhead Protection Program (327 IAC 8-4.1)	This rule establishes MCLs (40 CFR 141 and 327 IAC 8) as cleanup standards for impacted groundwater within established wellhead protection areas.	Location-specific	To be considered	The Site is not located within a wellhead protection area, but locations of wellhead protection areas will be considered during the remedial design.
Water Quality Standards (327 IAC 2)	These standards are for surface water quality in Indiana.	Chemical-specific	Potentially applicable	Applicability depends on the remedial action chosen. Program requirements apply to extracted groundwater discharged to waters of the U.S.
Groundwater Quality Standards (327 IAC 2-11)	These standards are for groundwater quality in Indiana and provide a groundwater classification plan.	Chemical-specific	Potentially applicable	Applicability will be further assessed during the FS.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Potential ARAR	Description	ARAR Type	Potentially Applicable or Relevant and Appropriate	Comment
ELKHART COUNTY AND CITY OF ELKHART				
Elkhart County Groundwater Protection Ordinance No. 09-172	The purpose of this ordinance is to enhance and preserve the public health, safety, and welfare of persons and property in Elkhart County by protecting the groundwater of Elkhart County from degradation resulting from the spills of toxic or hazardous substances. The ordinance applies to facilities that use, store, or generate toxic or hazardous substances, including construction sites where petroleum products (such as fuel) are stored.	Location-specific	Potentially applicable	Use or storage of hazardous materials may be required, depending on the remedial action chosen and the means and methods of construction of the selected remedy..
City of Elkhart Drilling Permits	The City of Elkhart requires that all excavations along city rights-of-way be permitted.	Action-specific	Potentially applicable	The substantive requirements are potentially applicable, depending on the remedy selected, and apply to remedies involving excavation in the City of Elkhart.
City of Elkhart Standard Construction Specifications	This requirement provides standard specifications for public works construction within the City of Elkhart. These include the local requirements for the design and construction of water mains and service connections.	Action-specific	Potentially applicable	The specifications are potentially applicable depending on the remedy selected and apply to the construction of utilities, such as water mains, turned over to the City of Elkhart.
City of Elkhart Wastewater Utility Use Ordinance and Wastewater Utility Policies	The ordinance provides criteria for industrial users of the City of Elkhart sewer system and publicly owned treatment works. The policy applies to all non-residential users of the City of Elkhart sewer system and POTW.	Action-specific	Potentially applicable	The substantive requirements of the ordinance and policy are potentially applicable, depending on the remedy selected, and would apply if wastewater is discharged to the City of Elkhart sewer system or POTW.

TABLE 2-1
POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Notes:

§	Section
§§	Sections
ARAR	Applicable or relevant and appropriate requirement
CFR	<i>Code of Federal Regulations</i>
EPA	U.S. Environmental Protection Agency
FFS	Focused Feasibility study
IAC	<i>Indiana Administrative Code</i>
IC	<i>Indiana Code</i>
IDEM	Indiana Department of Environmental Management
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
POTW	Publicly owned treatment works
RCRA	Resource Conservation and Recovery Act
RISC	Risk Integrated System of Closure
RSL	Regional Screening Level
USC	<i>United States Code</i>
VOC	Volatile organic compound

Source:

EPA. 2012. "Integrated Risk Information System (IRIS)." Accessed in January 2013. On-line Address:
<http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList>

TABLE 2-2
VALUES RELATING TO THE SELECTION OF REMEDIAL ACTION LEVELS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Analyte Name	Maximum Contaminant Level	Indoor Air, 10 ⁻⁶ /HI=1 (µg/m3)		Indoor Air 10 ⁻⁵ / HI = 1 (µg/m3)		Indoor Air 10 ⁻⁴ / HI = 1 (µg/m3)		Source
		Residential	Commercial	Residential	Commercial	Residential	Commercial	
PCE	5	9.4	47	42	180	42	180	MCL, VISL Calculator
TCE	5	0.43	3.0	2.21	8.8	2.1	8.8	MCL, VISL Calculator
Chloroform	80 as TTHM	0.11	0.53	1.1	5.3	11	53	MCL, VISL Calculator
1,1-DCA	2.4	1.5	7.7	15	77	150	770	MCL, VISL Calculator

Notes:

µg/L	Microgram per liter
µg/m ³	Microgram per cubic meter
DCA	Dichloroethane
MCL	Maximum Contaminant Level
PCE	Tetrachloroethene
TCE	Trichloroethene
TTHM	Total trihalomethanes
VISL	Vapor Intrusion Screening Level Calculator

- 1 The Indoor air RAL is that portion of the indoor air concentration attributed to vapor intrusion.
- 2 The indoor air values for PCE and TCE above the 10-5 risk are limited due to non-cancer effects.
- 3 Chloroform does not have a chemical-specific MCL but is part of an MCL for TTHM.

Source:

U.S. Environmental Protection Agency (EPA). 2011. "OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level (VISL) Calculator." November.

TABLE 2-3
GROUNDWATER AND VAPOR INTRUSION GENERAL RESPONSE ACTIONS
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

GRA	Description and Comments
No Action	Under the CERCLA-mandated no-action alternative, no action would be taken at the Site with respect to remediation.
ICs	This GRA includes administrative mechanisms (such as deed restrictions, ordinances, and permitting requirements) and use designations (such as designating water for non-potable use only) as well as physical actions (such as posting and fencing to restrict Site access and use).
VI Pathway Restriction	This GRA includes remedies that involve implemented processes to prohibit contaminated vapors from entering indoor air or to remove and destroy the vapors before they reach indoor air. This GRA may involve physical or chemical processes. Treatment is conducted on site.
Alternate Water Supply or Protection	This GRA includes remedies that implement processes to restrict the direct exposure pathway. Such remedies can include provision of alternate water supplies or water treatment prior to use. Contaminants are not treated, and underlying contamination remains. However, risk is reduced by eliminating the exposure pathway.

Notes:

CERCLA Comprehensive Environmental Response,
 Compensation, and Liability Act

GRA General response action

IC Institutional control

VI Vapor intrusion

TABLE 2-4
GROUNDWATER AND VAPOR INTRUSION CANDIDATE TECHNOLOGIES FOR RISK MITIGATION
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Candidate Technology	Description	Comments and Notes
No Action		
No action	CERCLA-mandated alternative of no action taken to mitigate risk	<ul style="list-style-type: none"> CERCLA-mandated
ICs		
Groundwater use restrictions	Stipulated limits on groundwater use; through community ordinance, require a permit for installation of groundwater wells and prohibit installation of new wells within IC zone; prohibit groundwater for potable use (industrial process water only); require properties with private wells to be connected to the city water supply; may include deed restrictions	<ul style="list-style-type: none"> May also be used in conjunction with remedies that leave behind residual contamination for an extended period of time Can be applied as an interim or permanent remedial action
Property access and use restrictions	Restriction to prevent property access; could be through posting or fencing; could also require use and maintenance of systems such as VI mitigation systems	<ul style="list-style-type: none"> May also be used in conjunction with remedies that leave behind residual contamination for an extended period of time
VI Pathway Restriction		
Passive barrier and venting	Installed beneath building to physically block entrance of vapors	<ul style="list-style-type: none"> Maintenance required to prevent tears and holes in barrier May not suffice as stand-alone technology Limited application for existing structures
Passive venting	Installation of venting layer below floor slab to allow soil gas to move laterally beyond building footprint under natural diffusion gradients or pressure	<ul style="list-style-type: none"> Venting relies on advective flow of air due to wind and heat stack effects Most effective in new constructions; not effective in existing structures
SSD	Pressure differential created across slab that favors movement of indoor air down into subsurface; can be installed as active or passive system	<ul style="list-style-type: none"> Very low-permeability soils may limit performance Effective for existing and new structures Most reliable, cost-effective, and efficient technology for controlling vapor intrusion
SSD and passive barrier	Same as SSD, with the addition of a passive barrier; the passive barrier, some designs of which can be applied on top of basement floors, provides an extra level of protection and would keep functioning even during power failures; barrier should enhance the performance of SSD	<ul style="list-style-type: none"> Very low-permeability soils may limit performance Effective for existing and new structures Passive barrier as retrofit either uses products adapted from other purposes (such as water-proofing paints or epoxy coatings) or new purpose-designed products with a very limited track record
Building pressurization	Involves adjusting building's HVAC system or installing new system to maintain positive pressure indoors relative to sub-slab area	<ul style="list-style-type: none"> More common for large commercial buildings and buildings with HVAC systems in place Effective for existing and new structures
Indoor air treatment	Treatment of air in existing or new facilities to remove vapor-phase contaminants; treatment includes carbon sorption, ozone oxidation, or photocatalytic oxidation	<ul style="list-style-type: none"> Typically generates a waste stream Effective capture of air contaminants may be difficult Energy-intensive, with significant O&M and monitoring burdens

TABLE 2-4
GROUNDWATER AND VAPOR CANDIDATE TECHNOLOGIES FOR RISK MITIGATION
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Candidate Technology	Description	Comments and Notes
Alternate Water Supply or Protection		
Whole-house treatment system	Water filter installed as whole-house filter where water enters the structure	<ul style="list-style-type: none">• Can be implemented very quickly• Effectiveness depends on user participation• Would not affect exposure from groundwater used for bathing purposes or VI• Requires ongoing maintenance
Point-of-use treatment system	Water filter installed at the point-of-use (at each faucet)	<ul style="list-style-type: none">• Can be implemented very quickly• Effectiveness depends on user participation• Would not affect exposure from groundwater being for bathing purposes or VI• Requires ongoing maintenance
Alternative water supply - bottled water	Bottled water provided for cooking and drinking use	<ul style="list-style-type: none">• Can be implemented very quickly• Effectiveness depends on user participation• Would not affect exposure from groundwater used for bathing purposes or VI• May be used as temporary solution until another remedy (such as installation of whole-house filters as a provision of municipal water supply) can be accomplished
Alternate water supply - municipal water	Where necessary, water mains extended; service connections made to residences and buildings to supply municipal water	<ul style="list-style-type: none">• Can be implemented in a short time• Provides long-term source of safe water for all domestic uses• Not effective at reducing VI

Notes:

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Constituent of concern
DPE	Dual-phase extraction
HVAC	Heating, ventilation, and air-conditioning
IC	Institutional control
ISCO	<i>In situ</i> chemical oxidation
MNA	Monitored natural attenuation
NAPL	Nonaqueous-phase liquid
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
POTW	Publicly owned treatment works
SSD	Sub-slab depressurization
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
VI	Vapor intrusion
VOC	Volatile organic compound
ZVI	Zero valent iron

TABLE 2-5
GROUNDWATER AND VAPOR INTRUSION REMEDIATION CANDIDATE TECHNOLOGIES SCREENING
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Technology	Effectiveness	Implementability	Relative Cost	Retained?	Reason for Elimination
				Interim	
No Action					
No action	<ul style="list-style-type: none">Capable of handling volume of groundwaterNot effective at reducing contaminationNot effective with respect to risk reduction	Easily implementable	Low	Yes	NA
ICs					
Groundwater use restrictions	<ul style="list-style-type: none">Not effective at reducing contamination but effective in reducing exposureNot entirely effective at reducing human health risk when used alone	Easily implementable	Low	Yes	NA
Property access and use restrictions	<ul style="list-style-type: none">Capable of handling volume of groundwaterNot effective at reducing contamination but effective in reducing exposureNot entirely effective at reducing human health risk when used alone	Easily implementable	Low	Yes	NA
VI Pathway Restriction					
Passive barrier and venting	<ul style="list-style-type: none">Not capable at handling vapor volumeNot effective at reducing contaminationNot effective with respect to risk reduction in existing structuresNot definitively effective with respect to risk reduction in new construction	Implementable	Moderate	No	This technology is less effective than other VI pathway restriction technologies and cannot be implemented in existing structures.
Passive venting	<ul style="list-style-type: none">Capable at handling vapor volumeNot effective at reducing contaminationNot effective with respect to risk reduction in existing structuresEffective with respect to risk reduction in new construction	Implementable	Moderate	No	This technology is less effective than other VI pathway restriction technologies and cannot be implemented in existing structures.
SSD	<ul style="list-style-type: none">Capable at handling vapor volumeNot effective at reducing contaminationEffective with respect to risk reduction in existing structuresEffective with respect to risk reduction in new construction	Easy to implement	Low	Yes	VI poses an immediate risk to human health. Therefore, it will be addressed through an interim action. The permanent solution to VI is to reduce groundwater contaminant concentrations to levels where VI does not pose risks.
SSD and passive barrier	<ul style="list-style-type: none">Capable of handling vapor volumeNot effective at reducing contaminationEffective with respect to risk reduction in new and existing structures.Potentially provides additional benefit over SSD alone because it would work even during power outage	Easy to implement	Low to moderate	Yes	Few products have been proven to provide a passive barrier in a retrofit application. The retrofit application is relatively new.

TABLE 2-5
GROUNDWATER AND VAPOR INTRUSION REMEDIATION CANDIDATE TECHNOLOGIES SCREENING
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Technology	Effectiveness	Implementability	Relative Cost	Retained?	Reason for Elimination
				Interim	
Building pressurization	<ul style="list-style-type: none"> Capable at handling vapor volume Not effective at reducing contamination Effective with respect to risk reduction in existing structures Effective with respect to risk reduction in new construction Effective only in buildings with suitable HVAC systems; each building would require individual evaluation 	Easy to difficult to implement	Low	Yes	VI poses an immediate risk to human health. Therefore, it will be addressed through an interim action. The permanent solution to VI is to reduce groundwater contaminant concentrations to levels where VI does not pose risks.
Indoor air treatment	<ul style="list-style-type: none"> Not capable at handling vapor volume Effective at reducing contamination Not effective with respect to risk reduction in existing structures Not effective with respect to risk reduction in new construction 	Difficult to implement	High	No	This technology is significantly more expensive than other VI pathway restriction technologies and is less effective at handling vapor volume and reducing risk.
Alternate Water Supply or Protection					
Whole-house treatment system	<ul style="list-style-type: none"> Capable of meeting all domestic water needs Not effective at reducing contamination (in the aquifer) Effective at reducing risk if maintained properly Can be implemented rapidly 	Implementable	Low	Yes	This technology is retained as an interim measure. It requires a very short time to implement (less than 1 day to 1 month). This technology is not suitable as a permanent measure because its effectiveness requires user participation and ongoing maintenance.
Point-of-use treatment system	<ul style="list-style-type: none"> Capable of meeting all domestic water needs Not effective at reducing contamination (in the aquifer) Effective at reducing risk if maintained properly Can be implemented rapidly 	Implementable	Low	Yes	This technology is retained as an interim measure. It requires a very short time to implement (less than 1 day to 1 month). This technology is not suitable as a permanent measure because its effectiveness requires user participation and ongoing maintenance.
Alternative water supply - bottled water	<ul style="list-style-type: none"> Capable of meeting drinking and cooking water needs Not effective at reducing contamination Effectiveness at risk reduction depends on users; not effective for inhalation exposure from water (such as bathing) Not effective at reducing risk from VI Can be implemented rapidly 	Implementable	Moderate	No	This technology is useful as an immediate or urgent measure, however present site conditions do not meet the requirements for a response action. It requires a very short time to implement (less than 1 day to 1 month). This technology is unsuitable as a permanent measure because its effectiveness requires user participation. Also, even as an interim measure, it does not address potential issues related to the inhalation of contaminated water during bathing or during the use of other fixtures connected to plumbing.
Alternate water supply - municipal water	<ul style="list-style-type: none"> Capable of meeting domestic water needs Not effective at reducing contamination (in the aquifer) Effective at reducing risk (except from VI) Not effective with respect to risk reduction in existing structures Effective with respect to risk reduction in new construction Most reliable means of providing safe water for potable use 	Implementable	Moderate	Yes	Municipal water supply can provide a permanent solution to the direct exposure pathway, but it would not meet other objectives, such as allowing potable use of groundwater or preventing VI.

Notes:

TABLE 2-5
GROUNDWATER AND VAPOR INTRUSION REMEDIATION CANDIDATE TECHNOLOGIES SCREENING
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

DPE	Dual-phase extraction	POTW	Publicly owned treatment works
HVAC	Heating, ventilation, and air-conditioning	NAPL	Nonaqueous-phase liquid
IC	Institutional controls	SSD	Sub-slab depressurization
ISCO	<i>In situ</i> chemical oxidation	SVE	Soil vapor extraction
MNA	Monitored natural attenuation	VI	Vapor intrusion
NA	Not applicable	ZVI	Zero valent iron
O&M	Operation and maintenance		
1	Technology may be used in conjunction with other technologies		

TABLE 2-6
GROUNDWATER AND VAPOR INTRUSION RETAINED TECHNOLOGIES FOR INTERIM USE
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

GRA	Candidate Technology	Comments ¹
No Action	No action	<ul style="list-style-type: none"> • CERCLA-mandated
ICs	Groundwater use restrictions	<ul style="list-style-type: none"> • Short-term remedy to reduce risk to human health • Typically not a stand-alone alternative, especially if groundwater used for potable purposes
	Property access and use restrictions	<ul style="list-style-type: none"> • Short-term remedy to reduce risk to human health • Typically not a stand-alone alternative
VI Pathway Restriction	SSD	<ul style="list-style-type: none"> • May be installed in existing and new structures • Short-term remedy to reduce risk to human health • Can be used for a long time if needed
	SSD and passive barrier	<ul style="list-style-type: none"> • May be installed in existing and new structures • Short-term remedy to reduce risk to human health • Can be used for a long time if needed • Provides additional protection by installing a barrier
	Building pressurization	<ul style="list-style-type: none"> • May be installed in existing and new structures • Short-term remedy to reduce risk to human health • Can be used for a long time if needed
Alternate Water Supply or Protection	Whole-house treatment system	<ul style="list-style-type: none"> • Can be implemented rapidly • Has O&M requirements • Success based on user participation
	Point-of-use treatment system	<ul style="list-style-type: none"> • Can be implemented rapidly • Presently being used • Has O&M requirements • Success based on user participation
	Alternate water supply - municipal water	<ul style="list-style-type: none"> • Once constructed, minimal O&M needed • Provides high degree of permanence

Notes:

CERCLA Comprehensive Environmental Response,
 Compensation, and Liability Act
 GRA General response action
 IC Institutional control

O&M Operation and maintenance
 SSD Sub-slab depressurization
 VI Vapor intrusion

1 All technologies for interim use will be combined with a permanent technology to ensure long-term protectiveness.

3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Technically feasible technologies retained after the screening discussed in [Section 2.7](#) above were combined to form remedial alternatives that may be applicable to OU 1 of the Lusher Site. Based on site-specific conditions, two sets of alternatives were developed: interim groundwater and interim VI mitigation alternatives. The interim alternatives provide rapid risk reduction, addressing RAOs 1 and 2 ([Section 2.3](#)) by addressing current exposure pathways, but not directly remediating the underlying contamination. The interim groundwater and VI alternatives are independent of one another (that is, any interim groundwater alternative can be used with any interim VI alternative). The interim alternatives would be used while the sources are fully characterized and controlled (as part of OU 2) and any required long term alternative has been selected and implemented.

This section describes the interim groundwater alternatives ([Section 3.1](#)) and interim VI mitigation alternatives ([Section 3.2](#)), as well as recommended pre-remedial VI sampling ([Section 3.3](#)).

3.1 INTERIM GROUNDWATER ALTERNATIVES

The interim groundwater alternatives are intended to address RAO 1 ([Section 2.3](#)). RAO 1 is to protect human health from chemical risks and hazards by preventing direct exposure to or potable use of groundwater containing COIs at levels resulting in unacceptable risk for current and future Site users, specifically current and future residents, industrial / commercial workers, utility workers, and construction workers.

No IC-only alternatives would be effective as interim groundwater alternatives, as they likely could not compel homeowners to pay the cost of connecting to the public water supply and/or installing and maintaining filtration systems. The following sections describe the three interim groundwater alternatives identified based on the technologies that passed the screening discussed in [Section 2.7](#). When an alternative is based on another alternative being implemented, this fact is noted in the description of that alternative.

3.1.1 Alternative IGW-1: No Action

Under this alternative, no action would be taken to mitigate risk. Evaluation of this alternative is required under the NCP. This alternative assumes that a No Action ROD is written, and therefore 5-year reviews will be required.

3.1.2 Alternative IGW-2: Filtered Water and Institutional Controls

Alternative IGW-2 would involve the addition of activated carbon in-line filters at properties located within the proposed interim groundwater remedial area that are currently occupied and not connected to a municipal water supply and ICs that create additional groundwater use and property access and use restrictions. The carbon filters would decrease risks from ingestion of contaminated groundwater, and the ICs would control current and future groundwater use at the Site. Based on property-specific circumstances, filters would be added either as whole-house or point-of-use filters – the decision about which type of filter to use would be made during the remedial design phase. For residences, whole-house filters are preferred, but for commercial and industrial facilities, point-of-use filters may be more appropriate. ICs would require ongoing maintenance of the filters and require that new constructions use municipal water (if available) or use filters. The ICs also would require the notification of construction and utility workers of the presence of potentially contaminated groundwater so that they could take appropriate precautions. Because contamination would be left in place, this alternative would require 5-year reviews. Additionally, the water filters would require regular O&M until they are no longer needed. This alternative would remain in place until the source(s) are controlled under OU 2 and a long-term groundwater alternative has been implemented and has achieved the RALs. An estimated 72 properties would receive filtered water under this alternative.

3.1.3 Alternative IGW-3: Municipal Water Supply, Institutional Controls, and Well Abandonment

Alternative IGW-3 would connect all currently occupied properties within the proposed interim groundwater remedial area not already connected to the City of Elkhart municipal water supply. Existing water wells would be abandoned following completion of the municipal water connections. An ordinance prohibiting the potable use of groundwater would be part of the remedy. This alternative would involve the extension of water mains and service connections where needed. The industrial (process) use of groundwater would not require restriction, but may be restricted anyway. Properly installed water supplies have long life spans and are expected to last for decades, with essentially no maintenance. The ICs would be similar to those discussed above under Alternative IGW-2. The ICs would require the notification of construction and utility workers of the presence of potentially contaminated groundwater so that they could take appropriate precautions. The ICs would remain in place until the source(s) are controlled under OU 2 and a long-term groundwater alternative has been implemented and has achieved the RALs. Additionally, once municipal water is supplied, under Alternative IGW-3, existing potable

water wells would be abandoned in accordance with state and local requirements to prevent their future use and future installation of private wells would be prohibited. Because contamination would be left in place, this alternative would require 5-year reviews.

3.2 INTERIM VAPOR INTRUSION MITIGATION ALTERNATIVES

As of January 21, 2013, OU 1 of the Lusher Site poses risks within the risk management range as identified in the NCP. However, these risks are not high enough to warrant action under a removal program (such as an emergency or time-critical removal action). The interim VI mitigation alternatives are intended to address RAO 2 ([Section 2.3](#)). RAO 2 is to protect human health from chemical risks and hazards posed by VI associated with groundwater contamination for current and future Site users, specifically residents and industrial / commercial workers, utility workers, construction workers, and recreationalists. In accordance with Region 5 Vapor Intrusion guidance, the risk level used in this FFS is based on an excess cancer risk of 1×10^{-5} and a non-cancer HI of 1. That guidance describes the basis for determining that a 1×10^{-5} risk level is protective and sufficiently conservative in its assumptions.

No IC-only alternatives would be effective for VI systems, as they likely could not compel homeowners to pay the cost of installing and maintaining mitigation systems. Because VI fundamentally results from contaminated groundwater (or soil), the only long-term remedy for the VI pathway is to treat or otherwise reduce concentrations of chemicals in groundwater near residences and other buildings so that they no longer pose unacceptable VI risk. However, due to the time necessary to identify the source areas, negotiate with potentially responsible parties, and investigate and remediate the source areas, the interim VI alternatives likely would be needed for many years. The following sections describe the three interim VI mitigation alternatives identified based on the technologies that passed the screening discussed in [Section 2.7](#). When an alternative is based on another alternative being implemented, this fact is noted in the description of that alternative.

An evaluation was made of the costs involved with performing the sampling necessary to identify properties which need remediation and those that would meet criteria for ongoing sampling, using several different scenarios. These scenarios are presented in Appendix B. The result of this evaluation indicates that, over a 10-year period, it will be less costly to pre-emptively mitigate the properties within the VI remedial area than it would be to sample and mitigate or monitor as needed. Therefore, the Alternatives below, excluding the No-Action alternative, assume pre-emptive mitigation.

3.2.1 Alternative IVIM-1: No Action

Under this alternative, no action would be taken to mitigate risk. Evaluation of this alternative is required under the NCP. This alternative assumes that a No Action ROD is written, and that, therefore, 5-year reviews will be required.

3.2.2 Alternative IVIM-2: Sub-Slab Depressurization System

Under Alternative IVIM-2, active SSD systems would be pre-emptively installed at all buildings in the Interim VI Remedial Area ([Section 2.5.2](#)). SSD systems are similar to radon mitigation systems. ICs would require each SSD system to be operated and maintained for the benefit of building occupants. ICs also would require that any new residential construction within the Interim VI Remedial Area be built with a VI mitigation system(s) as long as groundwater, sub-slab, and indoor air monitoring results indicate the need for such a system(s). For commercial and industrial buildings, during the design phase, other technologies (such as building pressurization) would be allowed. Ongoing soil vapor and sub-slab vapor monitoring, maintenance of the systems, and 5-year reviews would be required until monitoring results indicate no more unacceptable VI risk. This alternative is anticipated to remain in place until the source(s) are controlled under OU 2 and any required long-term groundwater alternative has been implemented and achieved its objectives.

3.2.3 Alternative IVIM-3: Sub Slab Depressurization System and Passive Barrier

Alternative IVIM-3 is similar to Alternative IVIM-2 above except that a passive barrier (such as waterproof paint or a purpose-designed sealer) would be applied to basement floors and walls as an additional physical barrier to prevent vapors from entering buildings. The physical barrier should minimize VI even when the SSD system is not functioning (as in the case of a power outage). For commercial and industrial buildings, during the design phase, other technologies (such as building pressurization) would be allowed. The alternative also would include ICs requiring that new buildings in the Interim VI Remedial Area ([Section 2.5.2](#)) be constructed with VI mitigation systems as long as monitoring results indicate the need for such systems. Ongoing soil vapor and sub-slab vapor monitoring, maintenance of the systems, and 5-year reviews would be required until monitoring results indicate no more unacceptable VI risk. Alternative IVIM-3 likely would require full implementation and success of the long-term groundwater alternative. This alternative is anticipated to remain in place until the source(s)

are controlled under OU 2 and a long-term groundwater alternative has been implemented and achieved the RALs.

3.3 PRE-REMEDIAL VAPOR INTRUSION SAMPLING

No pre-remedial sampling is needed to implement the interim groundwater alternatives. It is anticipated that these alternatives would be implemented proactively to address present and potential future risks.

As discussed in Section 3.2, an evaluation was made and alternatives IVIM-2 and IVIM-3 are based on pre-emptive mitigation. Pre-remedial vapor intrusion sampling would not be required for either of these alternatives. .

4.0 DETAILED ANALYSIS OF RETAINED ALTERNATIVES

This section presents the detailed analysis of interim remedial action alternatives for OU 1 at the Lusher Site. The detailed analysis is intended to provide decision-makers with information needed to select a remedial alternative that best meets the following CERCLA requirements:

- Protects human health and the environment
- Attains ARARs (or provides grounds for invoking a waiver)
- Uses permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practical
- Satisfies the preference for treatment that reduces toxicity, mobility, or volume of hazardous substances as a principal element
- Is cost-effective

Because this is an interim remedial action, permanence and treatment may be less significant factors, as they will be addressed more fully in the final remedy. The detailed analysis was performed in accordance with CERCLA Section 121 and EPA RI/FS Guidance ([EPA 1988](#)). The detailed analysis contains the following:

- A detailed description of each candidate remedial alternative, emphasizing the application of various component technologies
- An assessment of each alternative compared to the first seven of the nine evaluation criteria described in the NCP

The detailed description of each alternative includes a discussion of limitations, assumptions, and uncertainties for each component and provides a conceptual design for each alternative. Each remedial alternative was then evaluated against the first seven of the nine NCP evaluation criteria.

This section discusses the screening criteria ([Section 4.1](#)), followed by the individual alternative analyses ([Section 4.2](#)).

4.1 SCREENING CRITERIA

The nine NCP evaluation criteria can be subdivided into three categories: threshold criteria, primary balancing criteria, and modifying criteria, as discussed below.

4.1.1 Threshold Criteria

The threshold criteria relate to statutory requirements that each alternative must satisfy in order to be eligible for selection and include overall protection of human health and the environment and compliance with ARARs.

Overall Protection of Human Health and the Environment: This criterion assesses how well an alternative, as a whole, achieves and maintains protection of human health and the environment.

Compliance with ARARs: This criterion assesses how an alternative complies with location-, chemical-, and action-specific ARARs and whether a waiver is required or justified.

4.1.2 Primary Balancing Criteria

The primary balancing criteria are the technical criteria upon which the detailed analysis primarily is based and include long-term effectiveness and permanence; reduction of the toxicity, mobility, or volume of contaminants through treatment; short-term effectiveness; implementability; and cost.

Long-Term Effectiveness and Permanence: This criterion evaluates the effectiveness of an alternative in protecting human health and the environment after RAOs have been achieved. It also considers the degree to which treatment is irreversible and the type and quantity of residual contamination remaining after treatment. Long-term effectiveness will be addressed primarily through the final site remedy.

Reduction of Toxicity, Mobility, or Volume through Treatment: This criterion examines the effectiveness of an alternative in reducing the toxicity, mobility, or volume of the contamination or contaminants through treatment. The preference is to treat contaminants, preferably in an irreversible way, rather than just transfer contamination from one medium to another.

Short-Term Effectiveness: This criterion examines the effectiveness of an alternative in protecting human health and the environment during the construction and implementation of a remedy until RAOs have been achieved. It also considers protection of the community, workers, and the environment during the implementation of remedial actions. The detailed analysis of each alternative includes an estimate of the time necessary for completion of the alternative (the remedial duration). The timeframe estimates are based on published construction scheduling material and professional judgment.

Implementability: This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. Technical feasibility considers the ability to construct

and operate a remedy and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

Cost: This criterion evaluates the capital and O&M costs of each alternative.

[Appendix A](#) presents cost-estimate tables that provide the basis for the cost estimates for each alternative, including details and assumptions pertaining to the cost estimates, which also are discussed in each alternative's cost description in [Section 4.2](#). Present-worth costs are presented to help compare costs among alternatives and evaluate expenditures that occur over different time periods. The detailed analysis discounted future costs to a present worth. A discount rate of 7 percent was used to prepare the cost estimates (EPA 1988). Present worth represents the amount of money that, if invested now and disbursed as needed, would be sufficient to cover costs associated with the remedial action over its planned life. The present-worth cost and total cost for the lifetime of the remedial alternative were based on the estimated cleanup time (EPA 1988).

The cost estimate tables in [Appendix A](#) are intended to be within the target accuracy range of minus 30 percent to plus 50 percent of actual cost (EPA 1988). Assumptions used to develop cost alternatives may or may not remain valid during alternative implementation. Each cost estimate table also includes the following information as applicable:

- Capital, O&M, and monitoring costs
- Engineering design costs and project and construction management costs (including health and safety, legal, and administrative fees) as a percentage of direct capital costs
- A contingency to account for unforeseen project complexities such as adverse weather, the need for additional work based on unexpected Site conditions, and increased construction standby times as a percentage of direct capital costs

Because many of the components of the total cost are based on the number of buildings requiring an interim groundwater or interim VI remedy, available information was used to form the basis of assumptions used to estimate the costs. During the development of the RI, the City of Elkhart provided a list of addresses within the Lusher Site that have water accounts (Elkhart 2011). This list was cross-referenced with the Elkhart County GIS information and then checked against aerial photographs to eliminate lots with no structures. As discussed in Section 3.2, the costs for the interim vapor intrusion alternatives are based on pre-emptive mitigation. They are calculated for both the standard 30-year period

and a shorter 10-year period. The ten-year period assumes that other actions will have been taken to remediate the source areas and, potentially, the groundwater plume itself, removing the need for interim vapor intrusion mitigation.

Given the uncertainty associated with the limited data provided in the RI to identify which buildings are at risk from VI, as discussed in [Section 3.3](#), the RI report recommends pre-remedial VI sampling at each building within the Interim VI Remedial Area during the remedial design process to better establish a basis for remediation and a provide a more accurate estimate of the final cost of the remediation ([SulTRAC 2013](#)). Under EPA Region 5 guidance, locations where the VI risk exceeds 1×10^{-6} risk but is less than 1×10^{-5} should be monitored for potential VI ([EPA 2010](#)). Alternatively, a decision could be made to forego additional sampling and proactively mitigate VI at all homes in the VI area of concern. The costs associated with this FFS report include the costs for pre-remedial VI sampling but not for proactive mitigation of VI.

4.1.3 Modifying Criteria

The modifying criteria include state acceptance and community acceptance, which are assessed formally after receipt of state input on the FFS report and proposed plan for the Site and after the public comment period.

State Acceptance: This criterion considers the state's preferences among or concerns about the alternatives, including comments on ARARs or proposed use of waivers. This criterion is addressed after receipt of state input on the FFS report and proposed plan for the Site.

Community Acceptance: This criterion considers the community's preferences or concerns about the alternatives. This criterion is addressed after community input on the FFS report and proposed plan for the Site.

State Acceptance and Community acceptance will be evaluated in the ROD after the proposed plan has been prepared and the public comment period has ended.

4.2 INDIVIDUAL ALTERNATIVE ANALYSIS

As discussed in [Section 2.3](#), the current and future land uses for OU 1 are the same, with a mix of residential, recreational, and industrial / commercial properties. The following sections discuss the interim groundwater and interim VI mitigation based on future residential land-use scenarios.

4.2.1 Interim Groundwater Alternatives

This section describes each interim groundwater remedial alternative and assesses the alternative against the screening criteria discussed in [Section 4.1.1](#) and [Section 4.1.2](#). [Table 4-1A](#) summarizes the alternative evaluation. The interim groundwater alternatives are intended to rapidly eliminate current and potential future exposure pathways. They are not a permanent solution because they do not address the underlying contamination. A permanent solution requires that source control be implemented under OU 2 as well as a long-term groundwater remedial alternative.

4.2.1.1 Alternative IGW-1: No Action

Alternative IGW-1, No Action, was retained as a baseline against which to compare all other alternatives, as required by the NCP. This alternative does not include remedial action components to contain or eliminate exposure pathways by implementing ICs or environmental monitoring. As discussed in the Final RI report, there is limited evidence that degradation is occurring. Therefore, the primary mode of attenuation is expected to be dilution and plume movement ([SulTRAC 2013](#)). This alternative includes 5-year reviews, as contamination is left in place.

The following paragraphs assess the alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Current and future groundwater use present potential risks and hazards to human receptors. Some residents at the Site are currently exposed to drinking water above or close to MCLs. Under Alternative IGW-1, risk would be reduced only through natural attenuation of the contaminant plume. However, such attenuation, if any, would not be monitored. Therefore, it would not be known if attenuation is occurring. Alternative IGW-1 would not include any actions to control potential risks or hazards posed to human receptors. As a result, Alternative IGW-1 would not be protective of human health or the environment.

Compliance with ARARs: Because no action would be taken, ARARs do not apply.

Long-Term Effectiveness and Permanence: The groundwater plume(s) are expected to attenuate themselves over time. However, such attenuation, if any, would not be monitored. Therefore, it would not be known if attenuation is occurring or when risks have been reduced to acceptable levels.

Reduction of Toxicity, Mobility, and Volume through Treatment: Any reduction of the toxicity, mobility, or volume would not be through treatment but through natural attenuation. Alternative IGW-1 would not satisfy the statutory requirement for treatment.

Short-Term Effectiveness: Alternative IGW-1 would not impact the community, workers, or the environment because no remedial action would be implemented. The groundwater plume(s) are expected to attenuate themselves over time. However, such attenuation, if any, would not be monitored. Therefore, it would not be known if attenuation is occurring or when risks have been reduced to acceptable levels.

Implementability: Because no remedial action would be taken, implementability does not apply.

Cost: Because no remedial action would be taken, there only costs associated with this action are for 5-year reviews, which have a present worth value of \$52,000. The 5-year reviews are estimated at \$24,000 every 5 years.

4.2.1.2 Alternative IGW-2: Filtered Water and Institutional Controls

Alternative IGW-2 is an interim alternative designed to eliminate existing or potential exposure pathways. The alternative would reduce exposure to COCs but would not provide for any treatment of the groundwater plume. Therefore, the alternative would have to be used until such time as it is demonstrated that filtration is no longer needed. Alternative IGW-2 would provide for whole-building water filtration. For residences, it is anticipated and preferred that whole-house filters be used. For commercial and industrial facilities, point-of-use filters may be used instead because there is little health benefit in treating process water. The final decision about filter types would be made during the remedial design phase. The whole-house filter would reduce contaminant concentrations to acceptable levels by treating influent water from private wells to residential properties. Such treatment would involve installing activated carbon filtration units at each property's water main or lateral connection.

Figure 4-1 shows a schematic diagram of a typical whole-house filtration system. A typical filtration unit is 46 inches high and 52 inches long, includes an installation kit, and weighs approximately 40 pounds, with an effluent flow rate of 7 gallons per minute (gpm) and a capacity of about 300,000 gallons. Each unit would be equipped with (1) a pre-filtration device to filter out suspended particles and minute debris, (2) activated carbon or activated carbon and kinetic degradation fluxion (KDF) devices and post-filtration devices to filter out most chemical contaminants, and (3) an ultraviolet (UV) filtration device to treat biological contaminants such as bacteria and viruses. The goal would be to treat water so that it meets the RALs discussed in Section 2.4. Because some properties within the Lusher Site do not have sewer accounts, they are believed to use on-site wastewater disposal. Although the depth of many of the water supply wells is not known, some are known to be shallow and therefore easily susceptible to contamination from wastewater. For this reason, UV filtration would be required to verify that a safe

water supply is provided. To treat the contaminated groundwater, the treatment unit would be assembled onsite and flushed clean initially and every time the carbon components are changed out.

The exact installation locations at each building would be determined during the design phase. In general, it is anticipated that each filter system would be installed near the point of entry from the well water into each building. The detailed design of the systems would be developed more fully during the design phase.

Under this alternative, ICs would require all properties within the Lusher Site not connected to municipal water (approximately 78) to be fitted with and maintain a filtration system designed to remove COIs until it is demonstrated (as part of a long-term remedy) that filtration is no longer needed. Periodic sampling and testing would be performed to monitor the effectiveness of the alternative. In addition, to protect the public from possible exposure to contaminated groundwater in the private wells, public meetings and awareness sessions would be scheduled to create awareness about the dangers of residential well water use. No restrictions in use of the treated water would be necessary under this alternative.

The following paragraphs assess the alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Alternative IGW-2 is an interim alternative designed to eliminate current and potential exposure pathways. The alternative would meet the statutory requirement of overall protection of human health and the environment.

Compliance with ARARs: This alternative would comply with the appropriate ARARs.

Long-Term Effectiveness and Permanence: Alternative IGW-2 is an interim alternative designed to eliminate potential exposure pathways. Its long-term effectiveness would depend on the cooperation and participation of end-users in operating and maintaining the treatment systems, including periodic replacement of the filters. For this reason, the proposed alternative would provide moderate long-term effectiveness. Long-term effectiveness will be addressed primarily through the final site remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment: Alternative IGW-2 would reduce exposure to COIs and provide treatment for the groundwater that is extracted from the drinking water wells. That relatively limited point-of-service treatment would not provide for treatment of the entire groundwater plume, however.

Short-Term Effectiveness: The filtration system would have high short-term effectiveness if it is properly operated and maintained. There would be low risk to workers, the community, and the environment in implementing this alternative.

Implementability: Alternative IGW-2 would be easy to implement. Filtration systems have already been implemented at select locations at the Lusher Site and have been used at other sites. The alternative uses readily available skills and equipment, and the technology is reliable. Administratively, the most significant challenge likely would be enlisting the cooperation of residents, whose filters would require long-term O&M commitments and periodic access.

Cost: Alternative IGW-2 has an estimated present-worth value of \$1,741,000, which includes \$551,000 in capital costs and \$1,190,000 in present-value O&M costs. O&M costs are estimated at \$92,000 per year for 30 years, with an additional \$24,000 every five years for the 5-year reviews.

4.2.1.3 Alternative IGW-3: Municipal Water Supply, Institutional Controls, and Well Abandonment

Alternative IGW-3 is an interim alternative designed to eliminate existing and potential exposure pathways. The alternative would reduce exposure to COIs but would not provide for any treatment of the groundwater plume. Therefore, the alternative would have to be used until such time that it is demonstrated that groundwater is safe for potable use. Alternative IGW-3 would involve extension of the municipal water supply to areas currently not connected to it, including service connections. It would also include ICs prohibiting the potable use of groundwater within the Lusher Site and the abandonment of existing potable water supply wells. At this time, it is anticipated that industrial non-potable water wells would be allowed to remain in service. The ICs are anticipated to take the form of an ordinance prohibiting the potable use of groundwater and requiring connections to the public water system.

The implementation of this alternative is anticipated to require the construction of 3,280 feet of new water main and the installation of 78 new service connections and private well abandonments.

The following paragraphs assess the alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Alternative IGW-3 is an interim alternative designed to eliminate current and potential exposure pathways. The alternative would meet the statutory requirement of overall protection of human health and the environment.

Compliance with ARARs: This alternative would comply with the appropriate ARARs.

Long-Term Effectiveness and Permanence: Alternative IGW-3 would have high long-term effectiveness. It would reduce potential future risks by providing a safe municipal water supply to all areas of the Lusher Site. Little O&M would be required and, after initial implementation, further

coordination with residents would not be required. Long-term effectiveness concerning the contaminated groundwater will be addressed primarily through the final site remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment: Alternative IGW-3 would reduce exposure to COIs but would not provide for any treatment of the groundwater plume. Alternative IGW-3 would not satisfy the statutory preference for treatment.

Short-Term Effectiveness: After implementation, this alternative would have high short-term effectiveness. Because heavy construction would be required, there would be some risk to the community and environment during construction. However, these risks are no different than risks at other similar projects (such as the 2012 reconstruction of Lusher Avenue between Nappanee and 19th Streets) and are easily controlled.

Implementability: Technically and administratively, this alternative would be easy to implement. The technology is very reliable, and currently, much of the City of Elkhart is served by the municipal water system. Administratively, the most significant challenge likely would be enlisting the cooperation of residents with well abandonment. After implementation, property access would not be required.

Cost: Alternative IGW-3 has an estimated present-worth value (rounded to the nearest \$1,000) of \$1,961,000, which includes \$1,841,000 in capital costs and \$120,000 present-value O&M costs. O&M costs are estimated to be \$5,450 per year for 30 years with an additional \$24,000 every 5 years for the 5-year reviews.

4.2.2 Interim Vapor Intrusion Mitigation Alternatives

This section describes each interim VI mitigation remedial alternative and assesses the alternative against the screening criteria discussed in [Section 4.1.1](#) and [Section 4.1.2](#). [Table 4-1B](#) summarizes the alternative evaluation. The interim VI mitigation alternatives are intended to rapidly eliminate current and potential future exposure pathways. They are not a permanent solution at the Site because they do not address the underlying contamination. A permanent solution requires that source control be implemented at OU 2 as well as a long-term groundwater remedial alternative.

4.2.2.1 Alternative IVIM-1: No Action

Alternative IVIM-1, No Action, was retained as a baseline against which to compare all other alternatives as required by the NCP. This alternative does not include remedial action components to contain or eliminate exposure pathways by implementing ICs or environmental monitoring. This alternative includes

5-year reviews as contamination is left in place.

The following paragraphs assess the alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Current and future residents within the VI area of concern are subject to potential or actual risks associated with VI. Alternative IVIM-1 would not include any actions to control potential risks or hazards posed to human receptors. As a result, Alternative IVIM-1 would not be protective of human health or the environment.

Compliance with ARARs: Because no action would be taken, ARARs do not apply.

Long-Term Effectiveness and Permanence: The groundwater plume(s) are expected to attenuate themselves over time. However, such attenuation, if any, would not be monitored. Therefore, it would not be known if attenuation is occurring or when risks have been reduced to acceptable levels.

Reduction of Toxicity, Mobility, and Volume through Treatment: Any reduction of the toxicity, mobility, or volume would not be through treatment but through natural attenuation. Alternative IVIM-1 would not satisfy the statutory preference for treatment.

Short-Term Effectiveness: Alternative IVIM-1 would not impact the community, workers, or the environment because no remedial action would be implemented.

Implementability: Because no remedial action would be taken, implementability does not apply.

Cost: Because no remedial action would be taken, there only costs associated with this action are for 5-year reviews, which have a present worth value of \$52,000. The 5-year reviews are estimated at \$24,000 every 5 years.

4.2.2.2 Alternative IVIM-2: Sub-Slab Depressurization System

Alternative IVIM-2 is an interim alternative designed to eliminate potential exposure pathways. The alternative would reduce exposure to COIs but would not provide for any treatment of the groundwater plume. Therefore, the alternative would have to be used until it is demonstrated as part of the long-term remedy that SSD systems are no longer needed. For buildings with basements or slab-on-grade construction, Alternative IVIM-2 would involve extracting contaminants in the vapor phase from under slabs or membranes at the buildings. The SSD systems would prevent VOCs from entering structures by creating lower pressure beneath the foundations and venting vapors to the atmosphere. SSD systems have proven very effective in the past and are based on radon mitigation systems that have been modified for

VI mitigation. As discussed in Section 3.2, pre-emptive mitigation of all buildings within the VI remedial area is assumed under this alternative.

Figure 4-2 shows a schematic diagram of a typical SSD system. A typical system consists of polyvinyl chloride (PVC) piping that runs from extraction points in the basement along walls of buildings and vents at about roof level. The PVC piping would be connected to a fan intended to run continuously to create the vacuum under the slab, extract the vapor, and vent the vapor to the atmosphere above the roof line. An important component of the system would be sealing of cracks and other identified points of entry in the sub-grade levels.

For crawl spaces, a vapor barrier would be installed in the under-floor portion of the crawl space. Suction points would be provided beneath this vapor barrier, and vented gases would be exhausted above the roof level. For commercial or industrial buildings with suitable heating, ventilation, and air conditioning (HVAC) systems, if determined viable during the design phase, the HVAC system could be adjusted to provide a positive pressure relative to soil vapor to minimize VI. Sealing cracks and around other penetrations also would be a component at commercial or industrial buildings.

In all cases, ICs would require the continued operation of the SSD systems until it is determined that they are no longer needed and would require the installation of VI systems in all new construction within the VI area of concern.

The following paragraphs assess the alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Alternative IVIM-2 is an interim alternative designed to eliminate actual and potential exposure pathways. The alternative would meet the statutory requirement of overall protection of human health and the environment.

Compliance with ARARs: This alternative would comply with the appropriate ARARs.

Long-Term Effectiveness and Permanence: Alternative IVIM-2 is an interim alternative designed to eliminate potential exposure pathways. Its long-term effectiveness would depend on the cooperation and participation of end-users in operating and maintaining the SSD systems. For this reason, the proposed alternative would provide moderate long-term effectiveness. Long-term effectiveness concerning the contaminated groundwater will be addressed primarily through the final site remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment: Alternative IVIM-2 would reduce exposure to COIs but would not provide for any treatment of the groundwater plume. Alternative IVIM-2 would not satisfy the statutory preference for treatment. Therefore, the alternative would need to be used until it is demonstrated, as part of the long-term remedy, that the SSD systems are no longer needed. In addition, once the SSD system discharges VOCs to the air, the VOCs are expected to rapidly dissipate and degrade.

Short-Term Effectiveness: The alternative would be functional immediately after installation of the SSD system. System installation is anticipated to take less than 1 day at most residences. Within a few days of startup, the systems should achieve the RALs at each location. The SSD system would have high short-term effectiveness if it is properly operated and maintained. There would be low risk to workers, the community, and the environment in implementing this alternative.

Implementability: Alternative IVIM-2 would be easy to implement. The alternative uses readily available skills and equipment, and the technology is reliable. Administratively, the most significant challenge likely would be enlisting the cooperation of residents, whose SSD systems would require long-term O&M commitments and periodic access.

Cost: Alternative IVIM-2 has an estimated present-worth value (rounded to the nearest \$1,000) of \$791,000, which includes \$463,000 in capital costs and \$328,000 in present-value O&M costs over a 30 year period. Annual costs are estimated at \$22,000 for 30 years, with an additional \$24,000 every 5 years for the 5-year review. If the timeframe for analysis is reduced to 10 years, the present value of the remedy is reduced to \$669,000.

4.2.2.3 Alternative IVIM-3: Sub-Slab Depressurization System and Passive Barrier

Alternative IVIM-3 is similar to Alternative IVIM-2 except that a passive barrier would be added to subgrade surfaces. The passive barrier may be a proprietary product (such as RetroCoat™) designed for VI application or a basement water-proofing paint such as DryLok™ masonry water-proofer. Alternative barriers, such as Geo Seal®, Vapor-Vent™, LiquidBoot™, and GeoVent™, primarily are aimed at new construction or major retrofit applications and are not considered part of this alternative. However, during the design phase, these barriers could be used if deemed appropriate.

The following paragraphs assess this alternative against the threshold and primary screening criteria.

Overall Protection of Human Health and the Environment: Alternative IVIM-3 is an interim alternative designed to eliminate actual and potential exposure pathways. The alternative would meet the statutory requirement of overall protection of human health and the environment.

Compliance with ARARs: This alternative would comply with the appropriate ARARs.

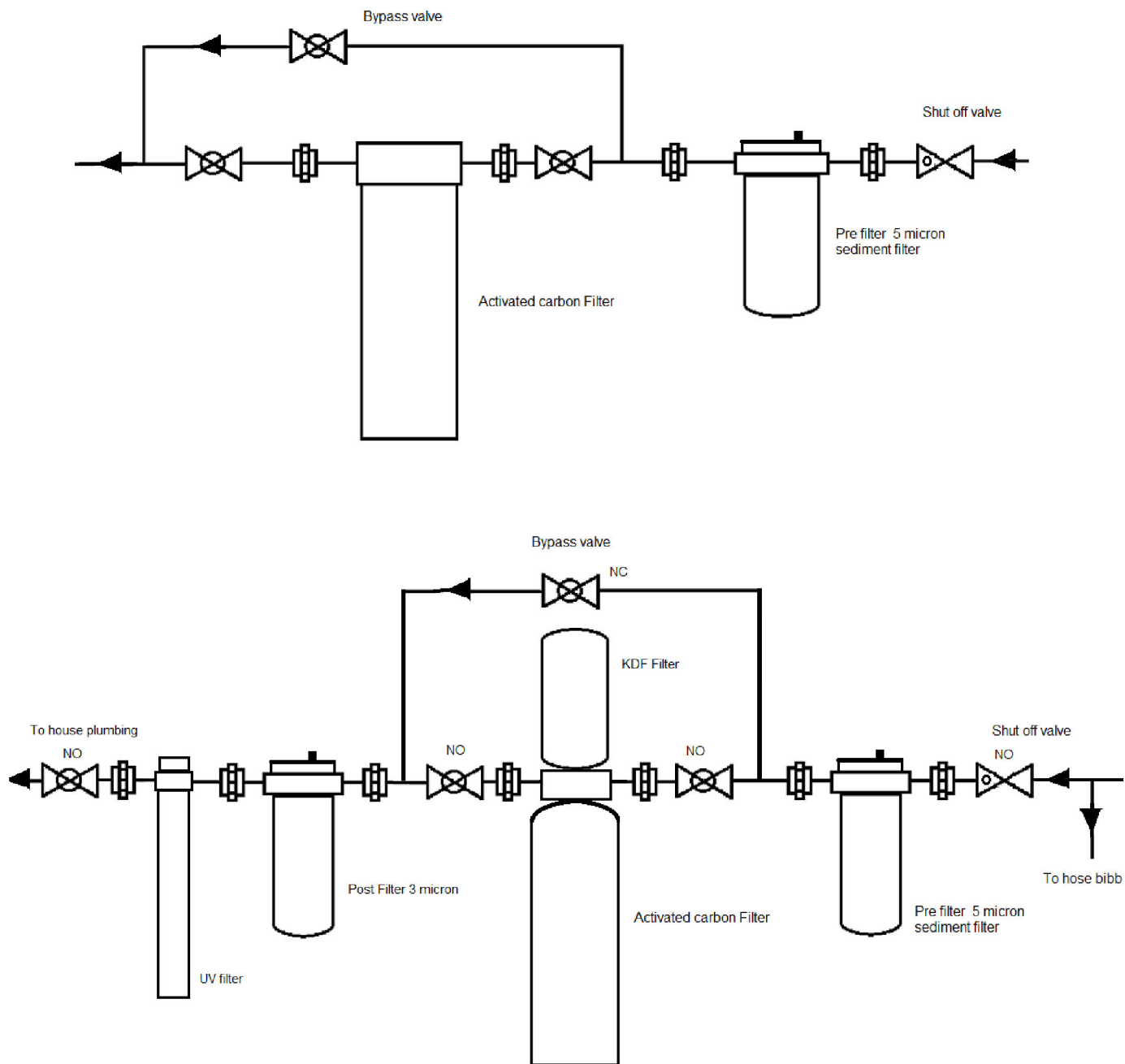
Long-Term Effectiveness and Permanence: Alternative IVIM-3 is an interim alternative designed to eliminate potential exposure pathways. Its long-term effectiveness would depend on the cooperation and participation of end-users in operating and maintaining the SSD systems. However, because Alternative IVIM-3 includes the addition of a barrier, the alternative would not completely depend on the cooperation and participation of end-users in operating and maintaining the SSD systems. Long-term effectiveness concerning the contaminated groundwater will be addressed primarily through the final site remedy.

Reduction of Toxicity, Mobility, and Volume through Treatment: Alternative IVIM-3 would reduce exposure to COIs but would not provide for any treatment of the groundwater plume. Alternative IVIM-3 would not satisfy the statutory requirement for treatment. Therefore, the alternative would need to be used in conjunction with a long-term remedy until it is demonstrated, as part of the long-term remedy, that SSD systems and passive barriers are no longer needed. In addition, once the SSD system discharges VOCs to the air, the VOCs are expected to rapidly dissipate and degrade.

Short-Term Effectiveness: The alternative would be functional immediately after installation of the SSD system. System installation is anticipated to take less than 1 day at most residences. Within a few days of startup, the systems should achieve the RALs at each location. The SSD system would have high short-term effectiveness if it is properly operated and maintained. Depending on the specific barrier selected, there may be some additional VOC exposure within allowable limits while the barrier (paint or other coating) is drying. There would be low risk to workers, the community, and the environment in implementing this alternative.

Implementability: Alternative IVIM-3 would be easy to implement. The alternative uses readily available skills and equipment, and the technology is reliable. However, some of the newer and proprietary barriers may not be as widely available. Administratively, the most significant challenge likely would be enlisting the cooperation of residents, whose SSD systems would require long-term O&M commitments and periodic access.

Cost: Alternative IVIM-3 has an estimated present-worth value (rounded to the nearest \$1,000) of \$1,653,000 which includes \$1,294,000 in capital costs and \$359,000 present value O&M costs. Annual costs are estimated at \$25,000, for 30 years, with an additional \$24,000 every 5 years for the 5-year review.



LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

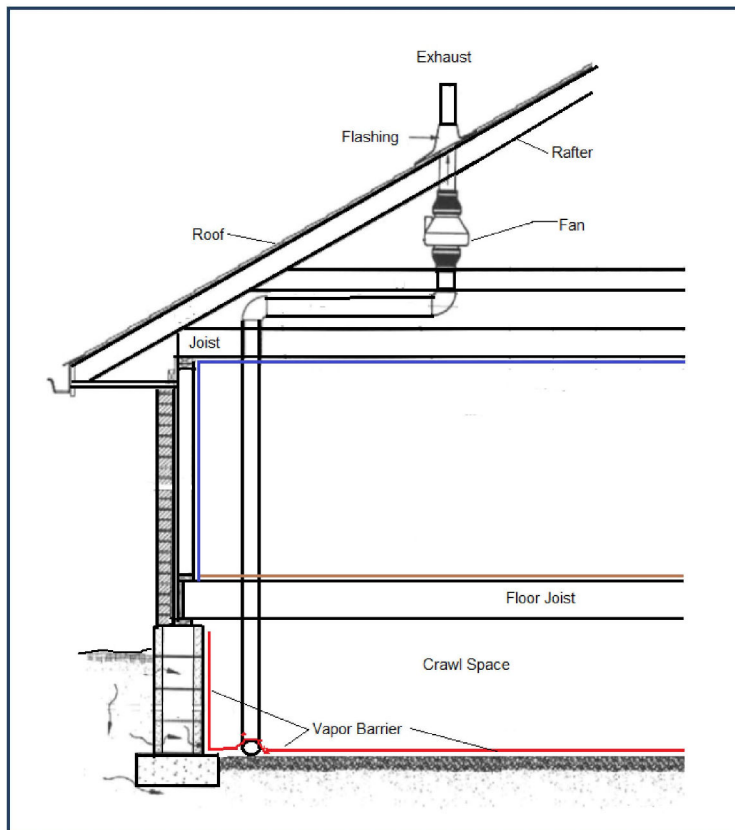
FINAL FOCUSED FEASIBILITY STUDY

FIGURE 4-1

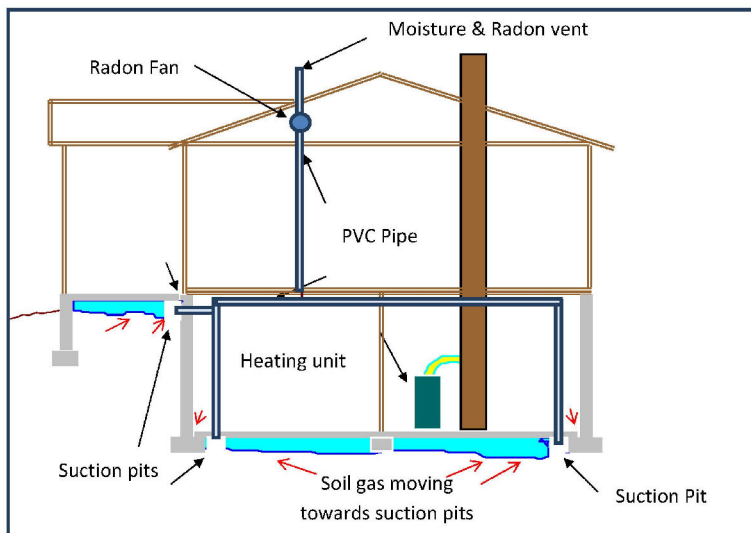
WHOLE-HOUSE FILTER SYSTEM SCHEMATIC

EPA REGION 5 RAC 2 | REVISION 0 | SEPTEMBER 2013





CRAWL SPACE RADON VENTING SYSTEM



SUB-SLAB RADON VENTING SYSTEM



LUSHER STREET GROUNDWATER CONTAMINATION SITE
ELKHART COUNTY, INDIANA

FINAL FOCUSED FEASIBILITY STUDY

FIGURE 4-2

SSD SYSTEM SCHEMATIC

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TABLE 4-1A
EVALUATION SUMMARY FOR INTERIM GROUNDWATER REMEDIAL ALTERNATIVES
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Evaluation Criteria	Alternative IGW-1 No Action	Alternative IGW-2 Filtered Water and ICs	Alternative IGW-3 Municipal Water Supply, ICs, and Well Abandonment
Overall Protection of Human Health and the Environment Protection of human health and the environment	Not protective	Protective	Protective
Compliance with ARARs Location-specific ARARs Action-specific ARARs Chemical-specific ARARs	Does not meet Does not meet Does not meet	Complies Complies Complies	Complies Complies Complies
Long-Term Effectiveness and Permanence Magnitude of residual risk Adequacy and reliability of controls 5-Year review	Residual risk remains. No controls Included.	Some residual risk if filters not changed as required Moderate reliability depending on property owner/occupant cooperation. Long term effectiveness will be addressed primarily through the final remedy. Required	Very low residual risk Very reliable. Overall long term effectiveness will be addressed primarily through the final remedy. Required
Reduction of Toxicity, Mobility, or Volume through Treatment Treatment processes used and materials treated Amount of hazardous material destroyed or treated Expected reduction in toxicity, mobility, or volume of waste Irreversibility of treatment Type and quantity of residuals remaining after treatment Statutory preference for treatment	None None None Not applicable Not applicable Does not satisfy	Would not treat contamination; alternative intended to control risk at receptor endpoint	Would not treat contamination; alternative intended to control risk at receptor endpoint
Short-Term Effectiveness Protection of workers during remedial action Protection of community during remedial action Potential environmental impacts of remedial action Time until protection is achieved	Not applicable Not applicable Not applicable Extremely long	Low risk to workers Low risk to community Very low risk of environmental impacts Short; upon completion of installation at each address	Low risk to workers Low risk to community Low risk of environmental impacts Short; upon completion of each section of water main and connection of service lines
Implementability Technical feasibility Reliability of technology Administrative feasibility Availability of services, equipment, and materials	Easy, no action is taken Not applicable East, no action is taken Not applicable	Easy Reliable depending on property owner participation and cooperation for routine filter change-outs Easy Readily available	Easy Very reliable; once installed, property access no longer required Easy Readily available
Cost Total construction cost Total engineering and construction management cost Total present-worth O&M cost Period of analysis (years) Total cost (including contingency)	\$0 \$0 \$52,000 Not applicable \$52,000	\$448,000 \$58,000 \$1,190,000 30 years \$1,741,000	\$1,497,000 \$344,000 \$120,000 30 years \$1,841,000

Notes:

Costs are rounded to the nearest \$1,000.
ARAR Applicable or relevant and appropriate requirement
IC Institutional control
O&M Operation and maintenance

TABLE 4-1B
EVALUATION SUMMARY FOR INTERIM VAPOR INTRUSION MITIGATION REMEDIAL ALTERNATIVES
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Evaluation Criteria	Alternative IVIM-1 No Action	Alternative IVIM-2 SSD System	Alternative IVIM 3 SSD System and Passive Barrier
Overall Protection of Human Health and the Environment Protection of human health and the environment	Not protective	Protective	Protective
Compliance with ARARs Location-specific ARARs Action-specific ARARs Chemical-specific ARARs	Does not meet Does not meet Does not meet	Complies Complies Complies	Complies Complies Complies
Long-Term Effectiveness and Permanence Magnitude of residual risk Adequacy and reliability of controls 5-Year review	Residual risk remains No controls Included	Low Moderate reliability as long as SSD system is turned on and adequately maintained. Long term effectiveness will be addressed primarily through the final remedy. Required	Low System has additional component (passive barrier) that could be effective even if SSD component is turned off. Long term effectiveness will be addressed primarily through the final remedy. Required
Reduction of Toxicity, Mobility, or Volume through Treatment Treatment processes used and materials treated Amount of hazardous material destroyed or treated Expected reduction in toxicity, mobility, or volume of waste Irreversibility of treatment Type and quantity of residuals remaining after treatment Statutory preference for treatment	 None None None Not applicable Not applicable Does not satisfy	 Would not treat contamination; alternative intended to control risk at receptor endpoint	 Would not treat contamination; alternative intended to control risk at receptor endpoint
Short-Term Effectiveness Protection of workers during remedial action Protection of community during remedial action Potential environmental impacts of remedial action Time until protection is achieved	Not applicable Not applicable Not applicable Extremely long	Low risk to workers Low risk to community Very low risk of environmental impacts Short; upon completion of installation at each address	Low risk to workers Low risk to community Low risk of environmental impacts Short; upon completion of installation at each address
Implementability Technical feasibility Reliability of technology Administrative feasibility Availability of services, equipment, and materials	Easy Not applicable Easy Not applicable	Easy. Reliable Easy Readily available	Easy. Reliable Easy Moderately to readily available depending on passive barrier selected
Cost Pre-remedial sampling Total construction cost Total engineering and construction management cost Total present-worth O&M cost Period of analysis (years) Total cost (including contingency)	\$0 \$0 \$0 \$52,000 30 years \$52,000 (\$29,000 over 10 years)	\$0 (pre-emptive mitigation is assumed) \$414,000 \$49,000 \$328,000 30 years \$791,000 (\$669,000 over 10 years)	\$0 (pre-emptive mitigation assumed) \$1,155,000 \$139,000 \$359,000 30 years \$1,653,000 (\$1,497,000 over 10 years)

Notes:

Costs are rounded to the nearest \$1,000.
ARAR Applicable or relevant and appropriate requirement
O&M Operation and maintenance
SSD Sub-slab depressurization

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparative analysis of the remedial alternatives for OU 1. [Section 4.2](#) presents the individual analysis of the remedial alternatives. There are two sets of alternatives: interim groundwater alternatives and interim VI mitigation alternatives. The interim alternatives are intended to provide rapid elimination of exposure pathways and would be needed until both (1) the sources are under control (OU 2) and (2) the need for potential further long-term actions has been evaluated and, if necessary, those actions are successfully implemented. Alternatives from each group can be implemented independently of any alternative in the other groups, although coordination of the ICs may be advisable.

Each interim alternative group consists of three alternatives: a “no action” alternative and two different “active” alternatives. In accordance with FS guidance, this section evaluates the no action alternative for each group ([EPA 1988](#)). As described in FS guidance, “The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decision maker must balance can be identified” ([EPA 1988](#)). The NCP is the basis for the comparative analysis and identifies nine criteria for the comparative analysis. This section of the FFS report evaluates the alternatives against the first seven criteria identified in the NCP. The remaining two criteria (state and community acceptance) will be evaluated in the Interim Record of Decision for OU 1 of the Lusher Site once formal comments on the FFS report and proposed plan have been received.

The following sections present the comparative analysis of alternatives and discuss the total costs associated with each alternative, followed by a summary of the comparative analysis. [Tables 5-1A and 5-1B](#), respectively, summarize the results of the comparative analysis for the interim groundwater and interim VI mitigation remedial alternatives. The tables evaluate each alternative against the threshold criteria on a pass or fail basis and the primary balancing criteria on a scale of 1 through 5, with 5 being the optimal score. [Appendix A](#) provides the detailed cost estimates.

5.1 INTERIM GROUNDWATER ALTERNATIVES

This section provides a comparative analysis of the interim groundwater alternatives. Interim groundwater alternatives are intended to achieve RAO 1 ([Section 2.3](#)). [Table 5-1A](#) summarizes the comparative analysis. The interim alternatives can be successfully implemented before the source control (OU 2) remedy has been selected and implemented.

5.1.1 Overall Protection of Human Health and the Environment

This criterion assesses how well an alternative achieves and maintains protection of human health and the environment. For the interim groundwater remedies, this criterion is evaluated in terms of overall effectiveness in achieving RAO 1.

Alternative IGW-1 (no action) would provide no improvement over current conditions and no risk reduction, and would not be protective of human health or the environment. Because Alternative IGW-1 does not pass this threshold criterion, the no-action alternative is not discussed further in this section of the FFS report. However, for comparison purposes, Alternative IGW-1 is scored within each category on Table 5-1A.

Alternatives IGW-2 and IGW-3 each would be effective interim remedies and reduce risks associated with direct exposure to contaminated groundwater. Direct exposure to groundwater could result from exposure to COIs through ingestion (drinking or cooking) and inhalation (vapors from water during the boiling of water or bathing). Alternative IGW-3 would be a bit more protective overall than Alternative IGW-2 because, under Alternative IGW-2, children and adults could be exposed to contaminated groundwater if filters are not changed when required.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses how an alternative complies with regulatory requirements. Federal and state regulatory requirements that are either applicable or relevant and appropriate are known as ARARs. Only state requirements that are more stringent than federal requirements are ARARs. The potential ARARs include chemical-, action-, and location-specific ARARs, as summarized in [Table 2-1](#).

Alternatives IGW-2 and IGW-3 would meet applicable ARARs.

5.1.3 Long-Term Effectiveness and Permanence

This criterion evaluates the effectiveness of an alternative in protecting human health and the environment when the cleanup is complete. It also considers the effectiveness of the cleanup over the long term.

Alternative IGW-3 would be more effective and permanent than Alternative IGW-2 because Alternative IGW-3 would not require ongoing O&M. The public water supply in the City of Elkhart presently meets all drinking water criteria. Additionally, under typical configurations for Alternative IGW-2, water used for outdoor purposes would not be filtered, allowing potential exposure to contaminants. Long-term

effectiveness concerning the contaminated groundwater plume will be addressed primarily through the final site remedy. This interim action is intended to contribute toward long-term effectiveness in a way that will be consistent with the final site remedy.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the preference for selecting remedial actions that use treatment technologies to permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances. This preference is satisfied when treatment reduces the principal threats at a site through the destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible encapsulation of contaminants, or reduction of the total volume of contaminated media. Alternative IGW-2 would provide some treatment of contaminated groundwater extracted by the residential wells and run through the filtration system. However, neither Alternative IGW-2 nor Alternative IGW-3 would significantly reduce the main contamination in the groundwater plume(s). Both alternatives are intended to prevent or minimize exposure to contaminated groundwater.

5.1.5 Short-Term Effectiveness

This criterion examines the effectiveness of an alternative in protecting human health and the environment during the cleanup until the cleanup is complete. It also considers protection of the community, workers, and the environment during the cleanup. For the interim groundwater alternatives, the short-term effectiveness criterion primarily relates to the time necessary to implement the remedy, potential risks to workers, and potential impacts to the community during construction.

Alternative IGW-2 could be implemented in less than 1 day per location after the equipment has been received and installation scheduled. Alternative IGW-3 also would have minimal impacts, and although it would take longer to install, it could be implemented within 3 months or less. Alternative IGW-2 would pose minimal risks to workers and the public. Risks would be slightly higher for Alternative IGW-3 due to the heavy construction and trenching involved with the installation of water and service lines. These risks could be easily mitigated and managed. Construction-related risks include the potential for vehicle accidents, traffic and noise from construction vehicles, increased wear on local roads, and other risks associated with construction work. These impacts could be mitigated by implementing a project-specific health and safety plan, keeping excavation areas properly braced, planning truck routes to minimize disturbances to the surrounding community, and other best management practices. The duration for

installation of Alternative IGW-2 is estimated at 40 working days. The duration for installation of Alternative IGW-3 is estimated at 160 working days.

5.1.6 Implementability

This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

Alternatives IGW-2 and IGW-3 are proven, readily implementable or easy to implement, and have been used successfully for other environmental cleanup projects. Qualified commercial contractors with experience would be available locally to perform the work. In addition, both alternatives would be administratively feasible. Although no permits would be required because the work would be performed under CERCLA, a similar level of coordination would be needed with state and local parties during design and construction activities for each active alternative. Administratively, the most significant challenge likely would be enlisting the cooperation of residents, whose filters would require long-term O&M commitments and periodic access under IGW-2 and whose wells would require abandonment under IGW-3.

5.1.7 Cost

This criterion evaluates the capital and O&M costs of each alternative. [Section 4.2](#) and [Appendix A](#) provide present-worth costs to help compare costs among alternatives with different implementation times.

Alternative IGW-2 has an estimated present-value cost (rounded to the nearest \$1,000) of \$1,741,000, with a capital cost of \$551,000 and annual O&M costs of \$92,000 for 30 years plus an additional \$24,000 every 5 years for the five year review.

Alternative IGW-3 is slightly more costly, with a present-value cost of \$1,961,000, a capital cost of \$1,841,000, and O&M costs of \$5,500. O&M costs for Alternative IGW-3 are low because, typically, water mains have long life expectancies (exceeding 100 years) and require minimal maintenance, primarily flushing the lines and exercising the valves.

5.2 INTERIM VAPOR INTRUSION MITIGATION ALTERNATIVES

This section provides a comparative analysis of the interim VI mitigation alternatives. Interim VI mitigation alternatives are intended to achieve RAO 2 ([Section 2.3](#)). [Table 5-1B](#) summarizes the comparative analysis. The interim alternatives can be successfully implemented before the source control (OU 2) remedy has been selected and implemented.

5.2.1 Overall Protection of Human Health and the Environment

This criterion assesses how well an alternative achieves and maintains protection of human health and the environment. In the case of the interim VI mitigation remedies, this criterion is evaluated in terms of overall effectiveness in achieving RAO 2.

Alternative IVIM-1 (no action) would provide no improvement over current conditions and no risk reduction, and would not be protective of human health or the environment. Because Alternative IVIM-1 does not meet this threshold criterion, the no-action alternative is not discussed further in this section of the FFS report. However, for comparison purposes, Alternative IVIM-1 will be scored within each category on [Table 5-1B](#).

Alternatives IVIM-2 and IVIM-3 each would be effective remedies and reduce risks associated with VI. Alternative IVIM-3 would be slightly more protective overall than Alternative IVIM-2 because in addition to the SSD system, a passive barrier would be added to further block VI.

5.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses how an alternative complies with regulatory requirements. Federal and state regulatory requirements that are either applicable or relevant and appropriate are known as ARARs. Only state requirements that are more stringent than federal requirements are ARARs. The potential ARARs include chemical-specific, action-specific, and location-specific ARARs as summarized in [Table 2-1](#).

Alternatives IVIM-2 and IVIM-3 would meet applicable ARARs.

5.2.3 Long-Term Effectiveness and Permanence

This criterion evaluates the effectiveness of an alternative in protecting human health and the environment when the cleanup is complete. It also considers the effectiveness of the cleanup over the long term.

Alternative IVIM-2 would be effective in the long term. Alternative IVIM-3 would be highly effective, the difference resulting from the addition of the barrier, which would provide a higher degree of permanence. Both alternatives would have a similar level of O&M requirements. Long-term effectiveness concerning the contaminated groundwater will be addressed primarily through the final site remedy. This interim action is intended to contribute toward long-term effectiveness in a way that will be consistent with the final site remedy.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the preference for selecting remedial actions that use treatment technologies to permanently and significantly reduce toxicity, mobility, or volume of hazardous substances. This preference is satisfied when treatment reduces the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible encapsulation of contaminants, or reduction of the total volume of contaminated media.

Neither Alternative IVIM-2 nor Alternative IVIM-3 would reduce the main contamination in the groundwater plume(s). Both alternatives would reduce exposure to contaminants by reducing risks from exposure to VI. By controlling exposure pathways, the alternatives would reduce mobility toward receptors within protected buildings. In addition, once the SSD system discharges VOCs to the air, the VOCs are expected to rapidly dissipate and degrade.

5.2.5 Short-Term Effectiveness

This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the cleanup until the cleanup is complete. It also considers protection of the community, workers, and the environment during the cleanup. For the interim VI alternatives, the short-term effectiveness criterion primarily relates to the time necessary to implement the remedy, potential risks to workers, and potential impacts to the community during construction. Short-term effectiveness of the remedial alternatives is summarized in Table 5-1B.

The SSD systems under Alternatives IVIM-2 and IVIM-3 typically could be installed in less than 1 day and therefore would have only a slight impact. Risks to workers and the public would be minimal. Alternative IVIM-3 likely would require installation over a several-day period, although the total installation time is likely to be less than 1 work day. This increased time would be required in order to prepare the barrier. Additionally, basements would have to be cleared of stored materials to allow access to apply the barrier material. Risks to workers and the public would be minimal, although there may be

some short-term odors from the application of the barrier material, some of which essentially are specialty paints.

5.2.6 Implementability

This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies. Administratively, the most significant challenge likely would be enlisting the cooperation of residents, whose SSD systems would require long-term O&M commitments and periodic access. IVIM-3 provides a physical barrier that would provide protection even if O&M proved difficult to implement.

Alternatives IVIM-2 and IVIM-3 are proven, readily implementable, and have been used successfully for other environmental cleanup projects. Qualified contractors with experience would be available locally to perform the work. Some barrier products are proprietary and may require application by a manufacturer-approved contractor. In addition, both alternatives would be administratively feasible. Although no permits would be required because the work would be performed under CERCLA, a similar level of coordination would be needed with state and local parties during design and construction activities for each active alternative.

5.2.7 Cost

This criterion evaluates the capital and O&M costs of each alternative. [Section 4.2](#) and [Appendix A](#) provide present-worth costs to help compare costs among alternatives with different implementation times.

Alternative IVIM-2 has an estimated present-value (rounded to the nearest \$1,000) cost of \$791,000 over 30 years (669,000 over 10 years), with a capital cost of \$463,000 and annual O&M costs of \$22,000.

Alternative IVIM-3 is the most costly of the interim VI mitigation alternatives, with a present-value cost of \$1,653,000 over 30 years, a capital cost of \$1,294,000, and annual O&M costs of \$25,000 per year for 30 years. Both Options IVIM-2 and IVIM-3 have an additional \$24,000 every 5 years in O&M costs for the 5-year reviews.

5.3 SUMMARY

The purpose of the comparative analysis was to identify the relative advantages and disadvantages of each remedial action alternative. [Tables 5-1A, and 5-1B](#), respectively, summarize the advantages and disadvantages of the interim groundwater and interim VI mitigation alternatives. For each set of alternatives, the no-action alternative failed to meet the threshold criteria and therefore was not further considered for the primary balancing and modifying criteria. The remaining alternatives passed the threshold criteria and were compared based on the primary and modifying criteria. In order of highest- to lowest-ranked alternative, the alternatives ranked as follows:

Interim Groundwater Alternatives

- Alternative IGW-3: Municipal Water Supply, ICs, and Well Abandonment
- Alternative IGW-2: Filtered Water and ICs

Interim VI Mitigation Alternatives

- Alternative IVIM-2: SSD System
- Alternative IVIM-3: SSD System and Passive Barrier

TABLE 5-1A
COMPARATIVE ANALYSIS OF INTERIM GROUNDWATER REMEDIAL ALTERNATIVES
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Evaluation Criteria	Remedial Alternatives		
	Alternative IGW-1 No Action	Alternative IGW-2 Filtered Water and ICs	Alternative IGW-3 Municipal Water Supply, ICs, and Well Abandonment
THRESHOLD CRITERIA ¹			
Overall protection of human health and the environment	Not protective; no action would be taken	Protective of direct groundwater use pathway	Protective of direct groundwater use pathway
Criterion Score	Fail	Pass	Pass
Compliance with ARARs	Does not comply	Meets ARARs	Meets ARARs
Criterion Score	Fail	Pass	Pass
PRIMARY BALANCING CRITERIA ²			
Long-term effectiveness and permanence	Ineffective and temporary	Effective	Highly effective and permanent
	Site conditions would remain the same	Depends on routine (annual) O&M of filters and necessary cooperation of building owners/occupants	Does not depend on cooperation of building owners/occupants once construction is complete
Criterion Score	1	3	5
Reduction of toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume	Somewhat effective	Somewhat effective
	No treatment applied	Alternative intended to control risks by eliminating exposure pathways	Alternative intended to control risks by eliminating exposure pathways
Criterion Score	1	2	2
Short-term effectiveness	No impacts because no implementation	Slight impact during installation	Minimal impact during implementation
	No worker risks because no action would be taken	Slight impact due to need to access and work inside privately owned houses and buildings	Minimal impact due to partial street closures necessary for installation of new water mains and service connections; some work inside privately owned building and houses required
Criterion Score	5	4	3
Implementability	Easy to implement	Readily implementable	Easy to implement
	Implementable because no action would be taken	Proven technology, however ongoing O&M inside private structures is required for full implementation.	Proven technology. Ongoing O&M not required inside private buildings.
Criterion Score	5	4	5
Cost (relative to other alternatives) ³			
Criterion Score	5	4	3
MODIFYING CRITERIA ⁴			
CERCLA Criteria - Alternative Total Score	Not applicable ¹	17	18
CERCLA Criteria - Alternative Rank	3	2	1

Notes:

- ARAR Applicable or relevant and appropriate requirement
- CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
- FS Feasibility study
- IC Institutional control
- O&M Operation and maintenance

- 1 The threshold criteria are evaluated on a pass or fail basis. An alternative must pass both threshold criteria to be considered as a remedial action. Alternatives that fail either threshold criterion rated as "not applicable" for the alternative total score.
- 2 The primary balancing criteria are evaluated on a scale of 1 through 5. Details are provided below.

<u>Long-term effectiveness and permanence:</u>	<u>Reduction of toxicity, mobility, or volume through treatment:</u>	<u>Short-term effectiveness (impact to community, site workers, and environment):</u>	<u>Implementability:</u>	<u>Cost (relative to other alternatives):</u>
1 = Ineffective and temporary	1 = Does not reduce toxicity, mobility, or volume	1 = Detrimental impacts during implementation	1 = Very difficult to implement	Ranked by total net present-value cost
2 = Somewhat effective	2 = Somewhat effective	2 = Significant impacts during implementation	2 = Difficult to implement	
3 = Effective	3 = Effective	3 = Minimal impacts during implementation	3 = Implementable	
4 = Highly effective	4 = Highly effective	4 = Slight impact during implementation	4 = Readily implementable	
5 = Highly effective and permanent	5 = Complete reduction of toxicity, mobility, and/or volume	5 = No impacts during implementation	5 = Easy to implement	

- 3 Section 4.2 and Appendix A of the FS report provide full presentation of the alternative costs.
- 4 The two modifying criteria, state acceptance and community acceptance, will be evaluated after comment on the FS report and the proposed plan and will be addressed in the Record of Decision.

TABLE 5-1B
COMPARATIVE ANALYSIS OF INTERIM VAPOR INTRUSION MITIGATION REMEDIAL ALTERNATIVES
LUSHER STREET GROUNDWATER CONTAMINATION SITE, OU 1

Evaluation Criteria	Remedial Alternatives		
	Alternative IVIM-1 No Action	Alternative IVIM-2 SSD System	Alternative IVIM-3 SSD System and Passive Barrier
THRESHOLD CRITERIA ¹			
Overall protectiveness of human health and the environment	Not protective; no action would be taken	Protective of VI pathway	Protective of VI pathway
Criterion Score	Fail	Pass	Pass
Compliance with ARARs	Does not comply	Meets ARARs	Meets ARARs
Criterion Score	Fail	Pass	Pass
PRIMARY BALANCING CRITERIA ²			
Long-term effectiveness and permanence	Ineffective and temporary	Effective	Highly effective and permanent
	Site conditions would remain the same	Depends on continual operation of system and regular O&M	Depends on continual operation of system and regular O&M; addition of passive barrier provides higher degree of permanence
Criterion Score	1	3	4
Reduction of toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume	Somewhat effective	Somewhat effective
	No treatment applied	Alternative intended to control risks by eliminating exposure pathways	Alternative intended to control risks by eliminating exposure pathways
Criterion Score	1	2	2
Short-term effectiveness	No impacts because no implementation	Slight impact during implementation	Minimal impact during implementation
	No worker risks because no action would be taken	Slight impact due to need to access and work inside privately owned houses and buildings	Minimal impact due to potential to access buildings over several days during installation; increased time required to install alternative and clear basements completely
Criterion Score	5	4	3
Implementability	Easy to implement	Readily implementable	Readily implementable
	Implementable because no action would be taken	SSD is a proven technology; however, ongoing O&M inside private structures required for full implementation; skills and equipment readily available	SSD is a proven technology; experience limited using passive barriers for retrofit applications to control VI; however, some technologies proven in basement waterproofing; skills and equipment readily available
Criterion Score	5	4	4
Cost (relative to other alternatives) ³			
Criterion Score	5	4	3
MODIFYING CRITERIA ⁴			
CERCLA Criteria - Alternative Total Score	Not applicable ¹	17	16
CERCLA Criteria - Alternative Rank	3	1	2

Notes:

ARAR Applicable or relevant and appropriate requirement FS Feasibility study SSD Sub-slab depressurization
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act O&M Operation and maintenance VI Vapor intrusion

- 1 The threshold criteria are evaluated on a pass or fail basis. An alternative must pass both threshold criteria to be considered as a remedial action. Alternatives that fail either threshold criterion rated as “not applicable” for the alternative total score.
2 The primary balancing criteria are evaluated on a scale of 1 through 5. Details are provided below.

<u>Long-term effectiveness and permanence:</u>	<u>Reduction of toxicity, mobility, or volume through treatment:</u>	<u>Short-term effectiveness (impact to community, site workers, and environment):</u>	<u>Implementability:</u>	<u>Cost (relative to other alternatives):</u>
1 = Ineffective and temporary	1 = Does not reduce toxicity, mobility, or volume	1 = Detrimental impacts during implementation	1 = Very difficult to implement	Ranked by total net present-value cost
2 = Somewhat effective	2 = Somewhat effective	2 = Significant impacts during implementation	2 = Difficult to implement	
3 = Effective	3 = Effective	3 = Minimal impacts during implementation	3 = Implementable	
4 = Highly effective	4 = Highly effective	4 = Slight impact during implementation	4 = Readily implementable	
5 = Highly effective and permanent	5 = Complete reduction of toxicity, mobility, and/or volume	5 = No impacts during implementation	5 = Easy to implement	

- 3 Section 4.2 and Appendix A of the FFS report present full details of the alternative costs.
4 The two modifying criteria, state acceptance and community acceptance, will be evaluated after comment on the FS report and the proposed plan, and will be addressed in the Record of Decision.

6.0 REFERENCES

- Agency for Toxic Substances and Disease Registry (ATSDR). 2009. "Public Health Assessment for Lusher Avenue Groundwater Contamination, Elkhart, Elkhart County, Indiana, EPA Facility ID IND982073785." July 14.
- City of Elkhart. 2011. List of addresses with water accounts and sewer accounts. Provided electronically. December 29.
- Indiana Department of Environmental Management (IDEM). 2007. "Site Inspection Report for Lusher Street Ground Water Contamination, Elkhart, Indiana, Elkhart County, USEPA ID IND982073785."
- SulTRAC. 2012. "Remedial Alternative Screening Technical Memorandum." Draft. Lusher Street Groundwater Contamination Site. November.
- SulTRAC. 2013. "Remedial Investigation Report, Final, Lusher Street Groundwater Contamination Site." September.
- U.S. Environmental Protection Agency (EPA). 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA." Interim Final. Office of Emergency and Remedial Response. Washington, DC. EPA/540/G-89/004. October.
- EPA. 1994. "National Oil and Hazardous Substances Pollution Contingency Plan, Revised." Title 40 of the *Code of Federal Regulations*, Parts 9 and 300. September 1994.
- EPA. 2010. "Vapor Intrusion Guidebook." Region 5 Superfund Division. October.
- EPA. 2011. "OSWER Vapor Intrusion Assessment, Vapor Intrusion Screening Level (VISL) Calculator." November.
- EPA. 2012. "Integrated Risk Information System (IRIS)." Accessed in January 2013. On-line Address: <http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList>
- Weston Solutions, Inc. (Weston). 2010. "Preliminary Investigation Report, Revision 0, for Lusher Street Groundwater Contamination Site, Elkhart, Indiana." March 16.

APPENDIX A
COST ESTIMATE TABLES

Table A-1
Interim Groundwater Cost Estimate Summary
Lusher Street Groundwater Contamination Site

Alternative	Alternative IGW-1	Alternative IGW-2	Alternative IGW-3
Item	No Action	Whole Building Water Filters	Municipal Water Supply
Capital Costs	\$0	\$550,881	\$1,841,309
O&M Costs	\$52,000	\$1,190,000	\$120,000
Total Costs	\$52,000	\$1,740,881	\$1,961,309

Notes:

All Capital Costs are assumed to occur in the first year.

O&M costs reflect present value and are for 30 years.

Table A-2A
Whole Building Filter Capital Costs
Lusher Street Groundwater Contamination Site

COST OF WHOLE HOUSE GAC FILTRATION SYSTEM			
	No. of residences	Unit cost	Cost
	78	\$ 3,484.18	\$ 271,766.04
		\$ 3,484.18	\$ -
	78	Subtotal	\$ 271,766.04
		Bonds, Insurance, Permits @ 3%	\$ 8,152.98
		Subtotal	\$ 279,919.02
		Scope contingency @ 35%	\$ 97,971.66
		Bid contingency @25%	\$ 69,979.76
		Total estimated construction cost	\$ 447,870.43
		Design @ 10%	\$ 44,787.04
		Project management @3%	\$ 13,436.11
		Construction management @10%	\$ 44,787.04
		TOTAL CAPITAL COST	\$ 550,880.63

Table A-2B
Water Filter Cost Detail
Lusher Street Groundwater Contamination Site

Filter System Cost					
Item	Manufacturer	Quantity	Unit	Unit Cost	Total
Stop and waste valve		1	each	\$ 40.97	\$ 40.97
True Union 1" Ball valves		4	each	\$ 99.40	\$ 397.60
PVC schedule 80 pipe		10	lf	\$ 20.11	\$ 201.10
1" Unions		7	each	\$ 95.97	\$ 671.79
1" 90 deg elbow		4	each	\$ 27.84	\$ 111.36
1" tees		3	each	\$ 43.22	\$ 129.66
GAC filter/iron and heavy metal	Sun Water System	1	each	\$ 769.30	\$ 769.30
5 micron pre-filter	GE, US Filter	1	each	\$ 26.25	\$ 26.25
3 micron post filter	GE, US Filter	1	each	\$ 15.00	\$ 15.00
UV disinfection unit	Trojen,	1	each	\$563	\$ 563.00
Testing/flushing/disinfect		1	ls	\$ 170.00	\$ 170.00
Labor to install		4	hr	\$ 65.00	\$ 260.00
Elect circuit for UV unit (15A)		1	ls	\$ 67.12	\$ 67.12
Sample and lab analytical		1	each	\$102	\$ 102.00
		-		\$ -	\$ -
				TOTAL	\$ 3,484.18

Note:

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3
Municipal Water Supply Capital Costs
Lusher Street Groundwater Contamination Site

Street	Water Main Cost	Units	Extended
Mobilization / Demobilization		1	\$ 10,000.00
Okema St. - N water main	\$ 33,792.35	1	\$ 33,792.35
Avalon St. water main	\$ 60,024.72	1	\$ 60,024.72
Lamar St. water main	\$ 25,060.17	1	\$ 25,060.17
Flake St. water main	\$ 20,210.76	1	\$ 20,210.76
Okema St. - S water main	\$ 53,901.45	1	\$ 53,901.45
<i>Subtotal - Water Mains</i>			\$ 202,989.45
Service Lines, well abandonment	\$ 8,368.38	78	\$ 652,733.95
tapping fees	\$675	78	\$52,650
<i>Subtotal - Svc Lines & Well abandonment</i>			\$ 705,383.95
Bonds, Insurance, Permits @ 3%			\$ 27,251.20
	Subtotal		\$ 935,624.60
Design contingency @ 35%			\$ 327,468.61
Construction contingency @25%			\$ 233,906.15
Total construction cost			\$ 1,496,999.37
Design @ 10%			\$ 149,699.94
Project management @3%			\$ 44,909.98
Construction management @10%			\$ 149,699.94
TOTAL PROJECT COST			\$ 1,841,309.22

Table A-3A
Alternative IGW-3 Detailed Costs
Lusher Street Groundwater Contamination Site

Okema Street					
Item	Manufacturers	Quantity	Unit Cost	Unit	Total
6" DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	620	\$ 29.00	ft	\$ 17,980.00
6" DI tee	Claw, US Pipe, American Pipe	1	\$ 120.00	each	\$ 120.00
6" gate valves		2	\$ 1,976.21	each	\$ 3,952.42
6" fire hydrants		1	\$ 2,287.03	each	\$ 2,287.03
Valve boxes	Tyler Pipe Industries	3	\$ 168.00	each	\$ 504.00
Excavation and backfill		413	\$ 11.30	cy	\$ 4,666.90
Roadway repair Asphalt		276	\$ 15.00	sy	\$ 4,140.00
Traffic control		1	\$ 142.00	ls	\$ 142.00
				Total	\$ 33,792.35

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3B
Alternative IGW-3 Detailed Costs
Lusher Street Groundwater Contamination Site

Avalon Street					
Item	Manufacturers	Quantity	Unit Cost	Unit	Total
6" DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	1,050	\$ 29.00	ft	\$ 30,450.00
6" DI tee	Claw, US Pipe, American Pipe	6	\$ 120.00	each	\$ 720.00
6" gate valves		3	\$ 1,976.21	each	\$ 5,928.63
6" fire hydrants		3	\$ 2,287.03	each	\$ 6,861.09
Valve boxes	Tyler Pipe Industries	6	\$ 168.00	each	\$ 1,008.00
Excavation and backfill		700	\$ 11.30	cy	\$ 7,910.00
Roadway repair Asphalt		467	\$ 15.00	sy	\$ 7,005.00
Traffic control		1	\$ 142.00	ls	\$ 142.00
				Total	\$ 60,024.72

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3C
Alternative IGW-3 Detailed Costs
Lusher Street Groundwater Contamination Site

Lamar Street					
Item	Manufacturers	Quantity	Unit Cost	Unit	Total
6" DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	150	\$ 29.00	ft	\$ 4,350.00
6" DI tee	Claw, US Pipe, American Pipe	2	\$ 120.00	each	\$ 240.00
6" gate valves		1	\$ 1,976.21	each	\$ 1,976.21
6" fire hydrants		1	\$ 2,287.03	each	\$ 2,287.03
4"x6" reducer		1	\$ 59.00	each	\$ 59.00
4"DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	320	\$ 29.62	ft	\$ 9,478.40
4" gate valves		1	\$ 1,481.63	each	\$ 1,481.63
Valve boxes	Tyler Pipe Industries	3	\$ 168.00	each	\$ 504.00
Excavation and Backfill		313	\$ 11.30	cy	\$ 3,536.90
Roadway repair Asphalt		67	\$ 15.00	sy	\$ 1,005.00
Traffic control		1	\$ 142.00	ls	\$ 142.00
				Total	\$ 25,060.17

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3D
Alternative IGW-3 - Detailed Costs
Lusher Street Groundwater Contamination Site

Flake Street					
Item	Manufacturers	Quantity	Unit Cost	Unit	Total
6" DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	0	\$ 29.00	ft	\$ -
6" DI tee	Claw, US Pipe, American Pipe	1	\$ 120.00	each	\$ 120.00
6" gate valves		0	\$ 1,976.21	each	\$ -
6" fire hydrants		0	\$ 2,287.03	each	\$ -
4"DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	380	\$ 29.62	ft	\$ 11,255.60
4" gate valves		2	\$ 1,481.63	each	\$ 2,963.26
4"DI tee		0	\$ 582.37	each	\$ -
Valve boxes	Tyler Pipe Industries	2	\$ 168.00	each	\$ 336.00
Excavation and backfill		253	\$ 11.30	cy	\$ 2,858.90
Roadway repair Asphalt		169	\$ 15.00	sy	\$ 2,535.00
Traffic control		1	\$ 142.00	ls	\$ 142.00
					\$ -
				Total	\$ 20,210.76

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3E
Alternative IGW-3 - Detailed Costs
Lusher Street Groundwater Contamination Site

Okema Street South					
Item	Manufacturers	Quantity	Unit Cost	Unit	Total
6" DI pipe AWWA C-151 Class 52	Claw, US Pipe, American Pipe	1,080	\$ 29.00	ft	\$ 31,320.00
6" DI tee	Claw, US Pipe, American Pipe	3	\$ 120.00	each	\$ 360.00
6" gate valves		2	\$ 1,976.21	each	\$ 3,952.42
6" fire hydrants		1	\$ 2,287.03	each	\$ 2,287.03
Valve boxes	Tyler Pipe Industries	3	\$ 168.00	each	\$ 504.00
Residential Service lines				each	\$ -
Excavation and backfill		720	\$ 11.30	cy	\$ 8,136.00
Roadway repair Asphalt		480	\$ 15.00	sy	\$ 7,200.00
Traffic control		1	\$ 142.00	ls	\$ 142.00
					\$ -
				Total	\$ 53,901.45

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Table A-3F
Alternative IGW-3 Detailed Costs
Lusher Street Groundwater Contamination Site

Service Line					
Item	Manufacturer	Quantity	Unit Cost	Unit	Total
Corporation cock	1" Mueller Oricorp H-15008	1	\$ 64.83	each	\$ 64.83
Service line	1" K-Copper	200	\$ 16.12	lf	\$ 3,224.00
Service shut off	1" Mueller Oriseal 3H-1504-2	1	\$ 144.84	each	\$ 144.84
Service shut off box	Tyler 95E	2	\$ 92.00	each	\$ 184.00
Water Meter	5/8" Neptune Model T-10	1	\$ 85.00	each	\$ 85.00
Excavation and backfill		89	\$ 11.30	cy	\$ 1,005.70
Pavement/sidewalk/yard repair		44	\$ 15.00	sy	\$ 660.00
Stop and waste valve, 1"		1	\$ 106.93	each	\$ 106.93
Gate valve, 1"		1	\$ 19.72	each	\$ 19.72
well abandonment, up to 150 ft deep		1	\$ 1,270.71	each	\$ 1,270.71
PRV	Watt Model No. U5 or U5B		\$ 270.77	each	\$ 270.77
Tapping sleeve	304 SS - Mueller H304		\$ 583.57	each	\$ 583.57
Tapping valve	Clow, Mueller		\$ 748.31	each	\$ 748.31
				TOTAL	\$ 8,368.38

Notes:

Assumes that excavated material is backfilled.

Manufacturer and model names are for reference only and do not constitute an endorsement by SulTRAC.

Service line tapping fees for the City of Elkhart are \$675 each.

Table A-4
O&M Costs, Alternatives IGW-2 and IGW-3
Lusher Street Groundwater Contamination Site

				Year	Alternative IGW-2			Alternative IGW-3		
Alternative IGW2: Whole House Filters					Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total
				1	\$0		\$0	\$91,739		\$91,739
<i>Operation and Maintenance</i>				2	\$0		\$0	\$91,739		\$91,739
Maintenance Labor (4 visits per year @ \$60/visit);				3	\$0		\$0	\$91,739		\$91,739
GAC/KDF changeout (use 1/3 of cost, estimated life is 3 years)				4	\$0		\$0	\$91,739		\$91,739
Electricity (estimated 500 kwh @ 0.09/kwh)				5	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
prefilter 5 micron (4 @ \$50/each)				6	\$0		\$0	\$91,739		\$91,739
post filter (4 @ \$60/each)				7	\$0		\$0	\$91,739		\$91,739
replacement UV lamp (1/year)				8	\$0		\$0	\$91,739		\$91,739
miscellaneous parts (o-rings)				9	\$0		\$0	\$91,739		\$91,739
<i>Total, per filter per year</i>				10	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
Number of Filters				11	\$0		\$0	\$91,739		\$91,739
<i>Total filter O&M costs per year</i>				12	\$0		\$0	\$91,739		\$91,739
				13	\$0		\$0	\$91,739		\$91,739
<i>Institutional Control Review</i>				14	\$0		\$0	\$91,739		\$91,739
<i>Institutional Control Review Site Visit (Annual)</i>				15	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
2 people for 1 day (with travel) at \$1,200 per person per day =				16	\$0		\$0	\$91,739		\$91,739
ODCs (car, per diem)				17	\$0		\$0	\$91,739		\$91,739
<i>Total</i>				18	\$0		\$0	\$91,739		\$91,739
<i>Institutional Control Review Report (Annual)</i>				19	\$0		\$0	\$91,739		\$91,739
20 hrs \$120 hr				20	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
<i>Total</i>				21	\$0		\$0	\$91,739		\$91,739
				22	\$0		\$0	\$91,739		\$91,739
<i>Remedy Review</i>				23	\$0		\$0	\$91,739		\$91,739
<i>Five Year Review - Site Inspection</i>				24	\$0		\$0	\$91,739		\$91,739
<i>Includes site visit to inspect each remediated yard</i>				25	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
2 people for 2 days (with travel) at \$1,200 per person per day =				26	\$0		\$0	\$91,739		\$91,739
ODCs (car, per diem)				27	\$0		\$0	\$91,739		\$91,739
<i>Total</i>				28	\$0		\$0	\$91,739		\$91,739
<i>Five Year Review Report</i>				29	\$0		\$0	\$91,739		\$91,739
150 hrs \$120 hr				30	\$0	\$24,050	\$24,050	\$91,739	\$24,050	\$115,789
ODCs										
<i>Total</i>										
					Net Present Value			Net Present Value		
					Annual O&M		\$0	Annual O&M		\$1,138,000
					Remedy Reviews		\$52,000	Remedy Reviews		\$52,000
					NPV =		\$52,000	NPV =		\$1,190,000
Alternative IGW-3: Municipal Water Connections										
Annual maintenance, by City crews, rates as published										
16 hrs \$25 hr										
Total							\$400			
<i>Institutional Control Review</i>										
<i>Institutional Control Review Site Visit (Annual)</i>										
2 people for 1 day (with travel) at \$1,200 per person per day =							\$2,400			
ODCs (car, per diem)							\$250			
<i>Total</i>							\$2,650			
<i>Institutional Control Review Report (Annual)</i>										
20 hrs \$120 hr							\$2,400			
<i>Total</i>							\$2,400			
<i>Remedy Review</i>										
<i>Five Year Review - Site Inspection</i>										
<i>Includes site visit to inspect each remediated yard</i>										
2 people for 2 days (with travel) at \$1,200 per person per day =							\$4,800			
ODCs (car, per diem)							\$250			
Total							\$5,050			
<i>Five Year Review Report</i>										
150 hrs \$120 hr							\$18,000			
ODCs							\$1,000			
Total							\$19,000			

Table A-5
IVIM Alternative Comparison
Lusher Street Groundwater Contamination Site

Alternative	Alternative IVIM-1	Alternative IVIM-2	Alternative IVIM-3
Item	No Action	SSD	SSD + Passive Barrier
Pre Remedial Sampling	\$0	\$0	\$0
Capital Costs	\$0	\$463,000	\$1,294,000
O&M Costs - 10 years	\$29,000	\$206,000	\$203,000
O&M Costs - 30 years	\$52,000	\$364,000	\$359,000
Total Costs - 10 years	\$29,000	\$669,000	\$1,497,000
Total Costs - 30 years	\$52,000	\$1,033,000	\$1,856,000

Notes:

All Capital Costs are assumed to occur in the first year.

O&M costs reflect present value and are for period indicated.

Because pre-emptive mitigation is assumed, there is no pre-remedial sampling.

No action costs include the cost of 5-year reviews.

Costs are rounded to nearest \$1,000.

Table A-6
Capital Costs Alternative IVIM-2 and 3
Lusher Street Groundwater Contamination Site

Basement Type	Total Quantity	Estimated Quantity	Assumed type of system	Alt IVIM-2		Alt IVIM-3	
				Unit Cost	Extended Cost	Unit Cost	Extended cost
Properties with Full Basements	70	70	SS	\$ 1,393.00	\$ 97,510.00	\$ 4,333.00	\$ 303,310.00
Properties with Basements & Slab-On-Grade	16	16	SS	\$ 1,393.00	\$ 22,288.00	\$ 4,333.00	\$ 69,328.00
Properties with Basements & Crawl Space	60	60	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 117,360.00	\$ 4,896.00	\$ 293,760.00
Properties with Slab-On-Grade	7	7	SS	\$ 1,393.00	\$ 9,751.00	\$ 4,333.00	\$ 30,331.00
Properties with Crawl Space	5	5	CS	\$ 3,603.00	\$ 18,015.00	\$ 6,543.00	\$ 32,715.00
Properties with Basements, Crawl Space and Slab-On-Grade	4	4	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 7,824.00	\$ 4,896.00	\$ 19,584.00
Basement type not available from county records	32	32	SS	\$ 1,393.00	\$ 44,576.00	\$ 4,333.00	\$ 138,656.00
Properties with Crawl Space & Slab-On-Grade	2	2	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 3,912.00	\$ 4,896.00	\$ 9,792.00
<i>Subtotal</i>					\$ 321,236.00		\$ 897,476.00
Bond, Insurance, Permits @ 3%					\$ 9,637.08		\$ 26,924.28
<i>Subtotal</i>					\$ 330,873.08		\$ 924,400.28
Scope Contingency @ 15%					\$ 49,630.96		\$ 138,660.04
Bid Contingency @ 10%					\$ 33,087.31		\$ 92,440.03
<i>Subtotal, Estimated Construction Costs</i>					\$ 413,591.35		\$ 1,155,500.35
Design @ 5%					\$ 20,679.57		\$ 57,775.02
Project Management @ 2%					\$ 8,271.83		\$ 23,110.01
Construction Management @ 5%					\$ 20,679.57		\$ 57,775.02
Total Estimated Capital Costs	196	196			\$ 463,222.31		\$ 1,294,160.39

Notes:

Total Quantity is the number of properties by basement type at the site. Estimated quantity assumes that 65% of the properties need remediation.

Properties with crawl space and another basement type are assumed to have a 250 SF crawl space for estimating purposes.

Alternative IVIM-3 adds a passive barrier, such as a waterproof paint, in addition to the mitigation system to the interior of the basement.

For estimating purposes, a total of 2000 sf needs to be painted (floor and walls). Cost is \$1.47 per SF.

Table A-6A
Alternative IVIM-2 and 3 Detailed Costs
Lusher Street Groundwater Contamination Site

CRAWL SPACE- SUBMEMBRANE RADON VENTING SYSTEM					
Item	Manufacturer	Quantity	Unit Cost	Unit	Total
4"- Radon venting fan	Radon Away RP 145-166 CFM	1	\$ 150.00	each	\$ 150.00
Fan mounting bracket		1	\$ 25.00	each	\$ 25.00
4"- Condensation Bypass		1	\$ 30.00	each	\$ 30.00
4"- Schedule 40 PVC venting line		60	\$ 1.62	lf	\$ 97.20
4"- Self-locking PVC Pipe Clamp		6	\$ 5.00	each	\$ 30.00
4"- Schedule 40 PVC fittings		1	\$ 8.00	ls	\$ 8.00
4" PVC vent cap		1	\$ 10.00	each	\$ 10.00
Piping installation		1	\$ 150.00	ls	\$ 150.00
12-mil polyethylene vapor barrier	Diamond back	1,300	\$ 2.25	sf	\$ 2,925.00
Miscellaneous		1	\$ 30.00	ls	\$ 30.00
Dedicated Electrical circuit		1	\$ 45.00	ls	\$ 45.00
Manometer - 4" to + 4" wc	Radon Away	1	\$ 8.00	each	\$ 8.00
Radon Mitigation Alarm	Radon Away recommended	1	\$ 75.00	each	\$ 75.00
Testing		2	\$ 100.00	each	\$ 200.00
Subtotal					\$ 3,783.20

Table A-6B
Alternative IVIM 2 and 3 Detailed Costs
Lusher Street Groundwater Contamination Site

BASEMENT SUBSLAB RADON VENTING SYSTEM					
Item	Manufacturer	Quantity	Unit Cost	Unit	Total
4"- Radon venting fan	Radon Away RP 145-	1	\$ 150.30	each	\$ 150.30
Fan mounting bracket		1	\$ 25.00	each	\$ 25.00
4"- Condensation Bypass		1	\$ 30.00	each	\$ 30.00
4"- Schedule 40 PVC venting line		100	\$ 1.62	lf	\$ 162.00
4"- Self-locking PVC Pipe Clamp		10	\$ 5.00	each	\$ 50.00
4"- Schedule 40 PVC fittings		1	\$ 8.00	ls	\$ 8.00
4" PVC vent cap		1	\$ 10.00	each	\$ 10.00
Piping installation		1	\$ 180.00	ls	\$ 180.00
subslab sump		2	\$ 250.00	each	\$ 500.00
Slab repair		2	\$ 50.00	each	\$ 100.00
Miscellaneous		1	\$ 30.00	ls	\$ 30.00
Dedicated Electrical circuit		1	\$ 45.00	ls	\$ 45.00
Manometer - 4" to + 4" wc	Radon Away	1	\$ 8.00	each	\$ 8.00
Radon Mitigation Alarm	Radon Away recomme	1	\$ 75.00	each	\$ 75.00
Testing		2	\$ 100.00	each	\$ 200.00
Subtotal					\$ 1,573.30

Table A-7
O&M Costs - IVIM Alternatives 1, 2 and 3
Lusher Street Groundwater Contamination Site

Alternative IVIM-1: No Action

Only the Remedy review costs identified below.

Alternative IVIM-2: Sub-Slab Depressurization

Operation and Maintenance

Fan Replacement, incl labor, est at 1/5 cost per year

Total, per system per year

Number of Systems

Total SSD O&M costs per year

Institutional Control Review

Institutional Control Review Site Visit (Annual)

2 people for 5 days (with travel) at \$1,200 per person per day =

ODCs (car, per diem) Inspection of each SSD system

Total

Institutional Control Review Report (Annual)

20 hrs

\$120 hr

Total

Remedy Review

Five Year Review - Site Inspection

Includes site visit in addition to IC review site visit

2 people for 2 days (with travel) at \$1,200 per person per day =

ODCs (car, per diem)

Total

Five Year Review Report

150 hrs

\$120 hr

ODCs

Total

Alternative IVIM-3; SS Depressurization plus passive barrier

Operation and Maintenance

Fan Replacement, barrier repair

Total, per system per year

Number of Filters

Total filter SSD costs per year

Institutional Control Review

Same as for IVIM-2

Remedy Review

Same as for IVIM-2

Year	Alternative IVIM-1			Alternative IVIM-2			Alternative IVIM-3				
	Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total		
1	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
2	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
3	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
4	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
5	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
6	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
7	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
8	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
9	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
10	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
11	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
12	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
13	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
14	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
15	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
16	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
17	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
18	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
19	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
20	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
21	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
22	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
23	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
24	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
25	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
26	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
27	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
28	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
29	\$0		\$0	\$25,132		\$25,132	\$24,774		\$24,774		
30	\$0	\$24,050	\$24,050	\$25,132	\$24,050	\$49,182	\$24,774	\$24,050	\$48,824		
Net Present Value (30 years)				Net Present Value (30 years)			Net Present Value (30 years)				
Annual O&M			\$0	Annual O&M			\$312,000	Annual O&M			\$307,000
Remedy Reviews			\$52,000	Remedy Reviews			\$52,000	Remedy Reviews			\$52,000
NPV (30 yr) =			\$52,000	NPV =			\$364,000	NPV =			\$359,000
Net Present Value (10 years)				Net Present Value (10 years)			Net Present Value (10 years)				
Annual O&M			\$0	Annual O&M			\$177,000	Annual O&M			\$174,000
Remedy Reviews			\$29,000	Remedy Reviews			\$29,000	Remedy Reviews			\$29,000
NPV (10 yr)=			\$29,000	NPV (10 yr)=			\$206,000	NPV (10 yr)=			\$203,000
Annual rate 7.0% over 5 years = 40.3%											

APPENDIX B
COST COMPARISON FOR PRE-EMPTIVE MITIGATION

Table B-1
Cost Comparison for Pre-Emptive Mitigation
Lusher Street Groundwater Contamination Site

Scenario	Scenario 1	Scenario 2A	Scenario 2B	Scenario 3	Scenario 4	Scenario 5A	Scenario 5B
Item	Pre-emptive Mitigation	SSD + Monitoring; 45% mitigated	SSD + Monitoring, 65% mitigated	All monitoring + NFA	All Monitoring	Monitoring 30%	Monitoring 60%
Quantity Sampled - 3 events	0	196	196	196	196	0	0
Quantity Mitigated	196	88	127	0	0	0	0
Quantiy Sampled - thru 10 years	0	67	28	155	196	59	118
Quantity as NFA	0	41	41	41	0	0	0
Construction Costs	\$463,000	\$207,000	\$299,000	\$0	\$0	\$0	\$0
O&M Costs, including sampling	\$206,000	\$1,008,000	\$781,000	\$1,471,000	\$1,760,000	\$882,000	\$1,562,000
Total Costs, Present value	\$669,000	\$1,215,000	\$1,080,000	\$1,471,000	\$1,760,000	\$882,000	\$1,562,000

Notes:

All Capital Costs are assumed to occur in the first year.
O&M costs reflect present value and are for 10 years.
Costs are rounded to the nearest \$1000.
Decisions are made in accordance with the Region 5 Vapor Intrusion Guidance.
The per-property costs are the same as used for Alternative IVIM-2.

	All scenarios are for a 10-year period.
Scenario 1:	Pre-emptive mitigation. All 196 properties receive mitigation proactively.
Scenario 2A:	All properties get 3 rounds of sampling, incl. at least 1 winter and 1 summer. 45% of properties get mitigated (Category 3 in at least 1 round) 21% are no further action (NFA), Category 1 in all rounds; remainder are Category 2 (resampling) Resampling is assumed to continue twice per year for a total of a 10 year period.
Scenario 2B	All properties get 3 rounds of sampling, incl at least 1 winter and 1 summer 65% of properties get mitigated; 21% are NFA Of the remainder, half get mitigated (FS assumption) and other have get monitored. Monitoring (sampling) continues twice per year for a 10 year period.
Scenario 3	All properties get 3 rounds of sampling, incl. at least 1 winter and 1 summer 21% NFA properties are not sampled further. Remaining properties are sampled until end of 10 year period.
Scenario 4	All properties get monitored twice per year for 10 years.
Scenario 5A	30% of homes (59 homes) will be sampled / monitored twice per year for 10 years. No mitigation is assumed. No NFA decisions are made on sampled / monitored homes.
Scenario 5B	60% of homes (118 homes)will be sampled/ monitored twice per year for 10 years No mitigation is assumed. No NFA decisions are made on sampled / monitored homes.

Table B-2
Cost Comparison for Pre-Emptive Mitigation
Lusher Street Groundwater Contamination Site

Estimated Quantity requiring mitigation								Extended Costs					
Basement Type	Total Quantity	Scenario 1: Pre-emptive Mitigaiton	Scenario 2: 45% need mitigation	Scenario 2B; 65% mitigation	Scenario 3: Sampling only + NFA	Scenario 4:Sampling g Only	Assumed type of system	Unit Cost	Scenario 1: Pre-emptive Mitigaiton	Scenario 2: 45% need mitigation	Scenario 2B; 65% mitigation	Scenario 3: Sampling only + NFA	Scenario 4:Sampling Only
Properties with Full Basements	70	70	32	46	0	0	SS	\$ 1,393.00	\$ 97,510.00	\$ 44,576.00	\$ 64,078.00	\$ -	\$ -
Properties with Basements & Slab-On-Grade	16	16	7	10	0	0	SS	\$ 1,393.00	\$ 22,288.00	\$ 9,751.00	\$ 13,930.00	\$ -	\$ -
Properties with Basements & Crawl Space	60	60	27	39	0	0	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 117,360.00	\$ 52,812.00	\$ 76,284.00	\$ -	\$ -
Properties with Slab-On-Grade	7	7	3	5	0	0	SS	\$ 1,393.00	\$ 9,751.00	\$ 4,179.00	\$ 6,965.00	\$ -	\$ -
Properties with Crawl Space	5	5	2	3	0	0	CS	\$ 3,603.00	\$ 18,015.00	\$ 7,206.00	\$ 10,809.00	\$ -	\$ -
Properties with Basements, Crawl Space and Slab-On-Grade	4	4	2	2	0	0	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 7,824.00	\$ 3,912.00	\$ 3,912.00	\$ -	\$ -
Basement type not available from county records	32	32	14	21	0	0	SS	\$ 1,393.00	\$ 44,576.00	\$ 19,502.00	\$ 29,253.00	\$ -	\$ -
Properties with Crawl Space & Slab-On-Grade	2	2	1	1	0	0	SS + 250SF CS Vapor barrier	\$ 1,956.00	\$ 3,912.00	\$ 1,956.00	\$ 1,956.00	\$ -	\$ -
Subtotal									\$ 321,236.00	\$ 143,894.00	\$ 207,187.00	\$ -	\$ -
Bond, Insurance, Permits @ 3%									\$ 9,637.08	\$ 4,316.82	\$ 6,215.61	\$ -	\$ -
Subtotal									\$ 330,873.08	\$ 148,210.82	\$ 213,402.61	\$ -	\$ -
Scope Contingency @ 15%									\$ 49,630.96	\$ 22,231.62	\$ 32,010.39	\$ -	\$ -
Bid Contingency @ 10%									\$ 33,087.31	\$ 14,821.08	\$ 21,340.26	\$ -	\$ -
Subtotal, Estimated Construction Costs									\$ 413,591.35	\$ 185,263.53	\$ 266,753.26	\$ -	\$ -
Design @ 5%									\$ 20,679.57	\$ 9,263.18	\$ 13,337.66	\$ -	\$ -
Project Management @ 2%									\$ 8,271.83	\$ 3,705.27	\$ 5,335.07	\$ -	\$ -
Construction Management @ 5%									\$ 20,679.57	\$ 9,263.18	\$ 13,337.66	\$ -	\$ -
Total Estimated Capital Costs	196	196	88	127	0	0			\$ 463,000.00	\$ 207,000.00	\$ 299,000.00	\$ -	\$ -

No Costs No Costs

Notes:
Total Quantity is the number of properties by basement type at the site. Estimated quantity varies by scenario.
Properties with crawl space and another basement type are assumed to have a 250 SF crawl space for estimating purposes.
Total Estimated capital costs are rounded to thenearest \$1,000.

Table B-2A
Crawl Space Cost Detail
Lusher Street Groundwater Contamination Site

CRAWL SPACE- SUBMEMBRANE RADON VENTING SYSTEM					
Item	Manufacturer	Quantity	Unit Cost	Unit	Total
4"- Radon venting fan	Radon Away RP 145-166 CFM	1	\$ 150.00	each	\$ 150.00
Fan mounting bracket		1	\$ 25.00	each	\$ 25.00
4"- Condensation Bypass		1	\$ 30.00	each	\$ 30.00
4"- Schedule 40 PVC venting line		60	\$ 1.62	lf	\$ 97.20
4"- Self-locking PVC Pipe Clamp		6	\$ 5.00	each	\$ 30.00
4"- Schedule 40 PVC fittings		1	\$ 8.00	ls	\$ 8.00
4" PVC vent cap		1	\$ 10.00	each	\$ 10.00
Piping installation		1	\$ 150.00	ls	\$ 150.00
12-mil polyethylene vapor barrier	Diamond back	1,300	\$ 2.25	sf	\$ 2,925.00
Miscellaneous		1	\$ 30.00	ls	\$ 30.00
Dedicated Electrical circuit		1	\$ 45.00	ls	\$ 45.00
Manometer - 4" to + 4" wc	Radon Away	1	\$ 8.00	each	\$ 8.00
Radon Mitigation Alarm	Radon Away recommended	1	\$ 75.00	each	\$ 75.00
Testing		2	\$ 100.00	each	\$ 200.00
Subtotal					\$ 3,783.20

Table B-2B
Sub-Slab Depressurization Detailed Costs
Lusher Street Groundwater Contamination Site

BASEMENT SUBSLAB RADON VENTING SYSTEM					
Item	Manufacturer	Quantity	Unit Cost	Unit	Total
4"- Radon venting fan	Radon Away RP 145- 166 CFM	1	\$ 150.30	each	\$ 150.30
Fan mounting bracket		1	\$ 25.00	each	\$ 25.00
4"- Condensation Bypass		1	\$ 30.00	each	\$ 30.00
4"- Schedule 40 PVC venting line		100	\$ 1.62	lf	\$ 162.00
4"- Self-locking PVC Pipe Clamp		10	\$ 5.00	each	\$ 50.00
4"- Schedule 40 PVC fittings		1	\$ 8.00	ls	\$ 8.00
4" PVC vent cap		1	\$ 10.00	each	\$ 10.00
Piping installation		1	\$ 180.00	ls	\$ 180.00
subslab sump		2	\$ 250.00	each	\$ 500.00
Slab repair		2	\$ 50.00	each	\$ 100.00
Miscellaneous		1	\$ 30.00	ls	\$ 30.00
Dedicated Electrical circuit		1	\$ 45.00	ls	\$ 45.00
Manometer - 4" to + 4" wc	Radon Away	1	\$ 8.00	each	\$ 8.00
Radon Mitigation Alarm	Radon Away recommended	1	\$ 75.00	each	\$ 75.00
Testing		2	\$ 100.00	each	\$ 200.00
Subtotal					\$ 1,573.30

Table B-3
Cost Comparison for Pre-Emptive Mitigation
O&M Costs
Lusher Street Groundwater Contamination Site

					Year	Scenario 1: Pre-emptive Mitigation			Scenario 2A: 3 Rounds Sampling + 45% Mitigation			Scenario 2B: 3 Rnds Sampling + 65% Mitigation			Scenario 3: 3 Rnds Sampling, Risk Mgmt 21% NFA			Scenario 4: All Sampling		
						Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total
SSD Operation and Maintenance (Applies to Scenarios 1, 2A, 2B)					1	\$25,132	\$0	\$25,132	\$288,796	0	\$288,796	\$290,434	0	\$290,434	\$268,200	\$0	\$268,200	\$268,200	\$0	\$268,200
					2	\$25,132	\$0	\$25,132	\$184,446	0	\$184,446	\$164,984	0	\$164,984	\$217,600	\$0	\$217,600	\$243,200	\$0	\$243,200
Fan Replacement, incl labor, est at 1/5 cost per year					3	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
Total, per system per year					4	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
Scenario S-1 S-2A S-2B					5	\$25,132	\$24,050	\$49,182	\$105,096	\$24,050	\$129,146	\$64,534	\$24,050	\$88,584	\$192,000	\$24,050	\$216,050	\$243,200	\$24,050	\$267,250
# Systems 196 88 127					6	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
Total per year \$8,232 \$3,696 \$5,334					7	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
Institutional Control Review (applies to all scenarios 1, 2A, and 2B)					8	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
					9	\$25,132	\$0	\$25,132	\$105,096	0	\$105,096	\$64,534	0	\$64,534	\$192,000	\$0	\$192,000	\$243,200	\$0	\$243,200
Institutional Control Review Site Visit (Annual)					10	\$25,132	\$24,050	\$49,182	\$105,096	\$24,050	\$129,146	\$64,534	\$24,050	\$88,584	\$192,000	\$24,050	\$216,050	\$243,200	\$24,050	\$267,250
2 people for 5 days (with travel) at \$1,200 per person per day =					11			\$12,000												
ODCs (car, per diem) Inspection of each SSD system					12			\$2,500												
Total					13			\$14,500 per event												
Institutional Control Review Report (Annual)					14															
20 hrs \$120 hr					15			\$2,400												
Total					16			\$2,400 per year												
Total ICR per year, all scenarios \$16,900					17															
Remedy Review (applies to all scenarios)					18															
Five Year Review - Site Inspection					19															
Includes site visit in addition to IC review site visit					20															
2 people for 2 days (with travel) at \$1,200 per person per day =					21			\$4,800												
ODCs (car, per diem)					22			\$250												
Total					23			\$5,050 per event												
Five Year Review Report					24															
150 hrs \$120 hr					25			\$18,000												
ODCs					26			\$1,000												
Total					27			\$19,000 per event												
					28															
Sample 196 + Sample Point Install \$ 146,600.00					29															
Sample 196 Scenario 5A 59 install \$ 50,250.00					30															
Sample 196 Sample 196 \$ 121,600.00 59 sample \$41,250.00																				
Sample 175 Sample 155 \$ 96,000.00 Scenario 5B 118 Install 118 sample \$89,950								\$177,000			\$979,000			\$752,000			\$1,442,000			\$1,731,000
								\$29,000			\$29,000			\$29,000			\$29,000			\$29,000
Sample 87 Sample 67 \$ 42,250.00								NPV = \$206,000			NPV = \$1,008,000			NPV = \$781,000			NPV = \$1,471,000			NPV = \$1,760,000
Sample 48 Sample 28 \$ 21,150.00								Annual rate 7.0% over 5 years = 40.3%												

Table B-3
Cost Comparison for Pre-Emptive Mitigation
O&M Costs
Lusher Street Groundwater Contamination Site

							Scenario 5A - Sample 30% homes (59 homes)			Scenario 5B - Sample 60% (118)				
							Year	No mitigation			No Mitigation			
								Annual O&M	Rem Review	Total	Annual O&M	Rem Review	Total	
SSD Operation and Maintenance Fan Replacement, incl labor, est at 1/5 cost per year <div>Total, per system per year</div> <div>Scenario S-1 S-2A S-2B</div> <div># Systems 196 88 127</div> <div>Total per year \$8,232 \$3,696 \$5,334</div>							1	\$	91,500.00			\$164,900		
							2		\$82,500.00			\$149,900		
							3		\$82,500.00			\$149,900		
							4		\$82,500.00			\$149,900		
							5		\$82,500.00	\$24,050		\$149,900	\$24,050	
							6		\$82,500.00			\$149,900		
							7		\$82,500.00			\$149,900		
							8		\$82,500.00			\$149,900		
							9		\$82,500.00			\$149,900		
							10		\$82,500.00	\$24,050		\$149,900	\$24,050	
Institutional Control Review Institutional Control Review Site Visit (Annual) 2 people for 5 days (with travel) at \$1,200 per person per day = ODCs (car, per diem) Inspection of each SSD system <div>Total</div> <div>Institutional Control Review Report (Annual)</div> <div>20 hrs \$120 hr</div> <div>Total</div> <div>Total ICR per year, all scenarios \$16,900</div>							11		\$12,000					
							12		\$2,500					
							13		\$14,500 per event					
							14							
							15		\$2,400					
							16		\$2,400 per year					
							17							
							18							
							19							
							20							
Remedy Review Five Year Review - Site Inspection Includes site visit in addition to IC review site visit 2 people for 2 days (with travel) at \$1,200 per person per day = ODCs (car, per diem) <div>Total</div> <div>Five Year Review Report</div> <div>150 hrs \$120 hr</div> <div>ODCs</div> <div>Total</div>							21		\$4,800					
							22		\$250					
							23		\$5,050 per event					
							24							
							25		\$18,000					
							26		\$1,000					
							27		\$19,000 per event					
							28							
							29							
							30							
Sample 196 + Sample Point Install \$ 146,600.00							Net Present Value			Net Present Value				
Sample 196 Sample 196 \$ 121,600.00							Annual O&M			Annual O&M				
Scenario 5A 59 install \$ 50,250.00							Remedy Reviews			Remedy Reviews				
Sample 175 Sample 155 \$ 96,000.00							NPV =			NPV =				
Scenario 5B 118 Install 118 sample \$89,950							\$834,000			\$1,514,000				
118 sample 118 sample \$74,950							\$48,000			\$48,000				
Sample 87 Sample 67 \$ 42,250.00														
Sample 48 Sample 28 \$ 21,150.00														

Table B-4A
Sampling Cost Detail
Lusher Street Groundwater Contamination Site

Sample 196 + Sample Port Installation				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 196 locations, TO-15 Analysis	392	\$ 150.00	each	\$ 58,800.00
Duplicate samples @ 10% frequency, TO-15 Analysis	39	\$ 150.00	each	\$ 5,850.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	25	\$ 150.00	each	\$ 3,750.00
2-person field team; set up 8 samples/day, 10 hour days	26	\$ 1,500.00	day	\$ 39,000.00
Travel costs; per person per day, including vehicle	26	\$ 200.00	each	\$ 5,200.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 5,000.00	LS	\$ 5,000.00
Driller, supplies, and cleanup	25	\$ 1,000.00	day	\$ 25,000.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 146,600.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
One round of sampling in each of the 196 buildings is assumed				

Sample 196 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 196 locations, TO-15 Analysis	392	\$ 150.00	each	\$ 58,800.00
Duplicate samples @ 10% frequency, TO-15 Analysis	39	\$ 150.00	each	\$ 5,850.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	25	\$ 150.00	each	\$ 3,750.00
2-person field team; set up 8 samples/day, 10 hour days	26	\$ 1,500.00	day	\$ 39,000.00
Travel costs; per person per day, including vehicle	26	\$ 200.00	each	\$ 5,200.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 5,000.00	LS	\$ 5,000.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 121,600.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
Sample ports are previously installed and usable				

Table B-4B
Sampling Cost Detail
Lusher Street Groundwater Contamination Site

Sample 155 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 155 locations, TO-15 Analysis	310	\$ 150.00	each	\$ 46,500.00
Duplicate samples @ 10% frequency, TO-15 Analysis	31	\$ 150.00	each	\$ 4,650.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 8 sampling days	19	\$ 150.00	each	\$ 2,850.00
2-person field team; set up 8 samples/day, 10 hour days	20	\$ 1,500.00	day	\$ 30,000.00
Travel costs; per person per day, including vehicle	20	\$ 200.00	each	\$ 4,000.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 4,000.00	LS	\$ 4,000.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 96,000.00
Notes: 24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples. Sample ports are previously installed and usable				

Sample 67 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 67 locations, TO-15 Analysis	134	\$ 150.00	each	\$ 20,100.00
Duplicate samples @ 10% frequency, TO-15 Analysis	13	\$ 150.00	each	\$ 1,950.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 8 sampling days	8	\$ 150.00	each	\$ 1,200.00
2-person field team; set up 8 samples/day, 10 hour days	9	\$ 1,500.00	day	\$ 13,500.00
Travel costs; per person per day, including vehicle	9	\$ 200.00	each	\$ 1,800.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 1,700.00	LS	\$ 1,700.00
Data review, evaluation and decision making,	20	\$ 100.00	hours	\$ 2,000.00
Subtotal				\$ 42,250.00
Notes: 24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples. Sample ports are previously installed and usable				

Sample 28 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 28 locations, TO-15 Analysis	56	\$ 150.00	each	\$ 8,400.00
Duplicate samples @ 10% frequency, TO-15 Analysis	6	\$ 150.00	each	\$ 900.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 4 sampling days	4	\$ 150.00	each	\$ 600.00
2-person field team; set up 8 samples/day, 10 hour days	5	\$ 1,500.00	day	\$ 7,500.00
Travel costs; per person per day, including vehicle	5	\$ 200.00	each	\$ 1,000.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 750.00	LS	\$ 750.00
Data review, evaluation and decision making,	20	\$ 100.00	hours	\$ 2,000.00
Subtotal				\$ 21,150.00
Notes: 24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples. Sample ports are previously installed and usable				

Table B-4C
Sampling Cost Detail - Scenarios 5A and 5B
Lusher Street Groundwater Contamination Site

Sample 59 + Sample Port Installation				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 59 locations, TO-15 Analysis	118	\$ 150.00	each	\$ 17,700.00
Duplicate samples @ 10% frequency, TO-15 Analysis	12	\$ 150.00	each	\$ 1,800.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	8	\$ 150.00	each	\$ 1,200.00
2-person field team; set up 8 samples/day, 10 hour days	9	\$ 1,500.00	day	\$ 13,500.00
Travel costs; per person per day, including vehicle	9	\$ 200.00	each	\$ 1,800.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 1,250.00	LS	\$ 1,250.00
Driller, supplies, and cleanup	9	\$ 1,000.00	day	\$ 9,000.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 50,250.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
One round of sampling in each of the 196 buildings is assumed				

Sample 59 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 59 locations, TO-15 Analysis	118	\$ 150.00	each	\$ 17,700.00
Duplicate samples @ 10% frequency, TO-15 Analysis	12	\$ 150.00	each	\$ 1,800.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	8	\$ 150.00	each	\$ 1,200.00
2-person field team; set up 8 samples/day, 10 hour days	9	\$ 1,500.00	day	\$ 13,500.00
Travel costs; per person per day, including vehicle	9	\$ 200.00	each	\$ 1,800.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 1,250.00	LS	\$ 1,250.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 41,250.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
Sample ports are previously installed and usable				

Sample 118 + Sample Port Installation				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 118 locations, TO-15 Analysis	236	\$ 150.00	each	\$ 35,400.00
Duplicate samples @ 10% frequency, TO-15 Analysis	24	\$ 150.00	each	\$ 3,600.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	15	\$ 150.00	each	\$ 2,250.00
2-person field team; set up 8 samples/day, 10 hour days	16	\$ 1,500.00	day	\$ 24,000.00
Travel costs; per person per day, including vehicle	16	\$ 200.00	each	\$ 3,200.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 2,500.00	LS	\$ 2,500.00
Driller, supplies, and cleanup	15	\$ 1,000.00	day	\$ 15,000.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 89,950.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
One round of sampling in each of the 196 buildings is assumed				

Sample 118 Locations				
Item	Quantity	Unit Cost	Unit	Total
Paired Sub-slab & Indoor Air samples, 118 locations, TO-15 Analysis	236	\$ 150.00	each	\$ 35,400.00
Duplicate samples @ 10% frequency, TO-15 Analysis	24	\$ 150.00	each	\$ 3,600.00
Outdoor Air samples, 1 per day, TO-15 Analysis, 25 sampling days	15	\$ 150.00	each	\$ 2,250.00
2-person field team; set up 8 samples/day, 10 hour days	16	\$ 1,500.00	day	\$ 24,000.00
Travel costs; per person per day, including vehicle	16	\$ 200.00	each	\$ 3,200.00
Miscellaneous costs (shipping, misc. field supplies)	1	\$ 2,500.00	LS	\$ 2,500.00
Data review, evaluation and decision making,	40	\$ 100.00	hours	\$ 4,000.00
Subtotal				\$ 74,950.00
Notes:				
24-hour samples are assumed. Therefore one additional day is needed to pick up the last samples.				
Sample ports are previously installed and usable				